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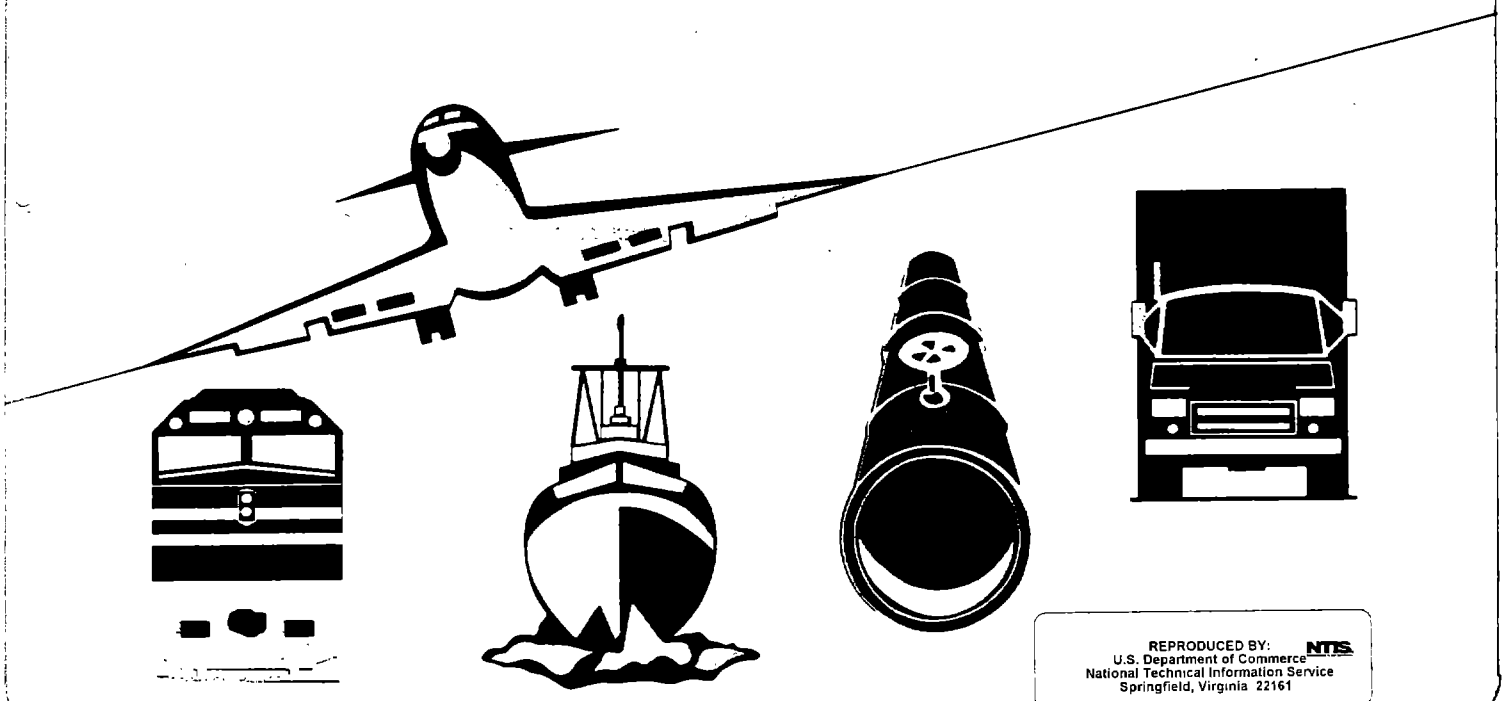
NATIONAL TRANSPORTATION SAFETY BOARD

TRANSPORTATION SAFETY RECOMMENDATIONS

ADOPTED DURING THE MONTH OF MAY, 1998



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16. Abstract

This publication contains safety recommendations in highway and marine modes of transportation adopted by the National Transportation Safety Board during the month of May, 1998.

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National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: May 18, 1998

In reply refer to: H-98-27

Honorable Rodney E. Slater
Secretary
U.S. Department of Transportation
Washington, D.C. 20590

On October 9, 1997, about 12:10 a.m., a 1994 Mack truck tractor pulling a 1994 Fruehauf MC-306 cargo tank semitrailer was heading south on Central Park Avenue in Yonkers, New York. The truck, which was loaded with 8,800 gallons of gasoline, was just going under an overpass of the New York State Thruway (Thruway) when it was struck by a southbound 1990 Eagle Premier sedan. The car hit the right side of the cargo tank in the area of the tank's external loading unloading lines (loading lines), releasing the gasoline they contained. The ensuing fire destroyed both vehicles and the overpass of the Thruway; the Thruway remained closed for approximately 6 months. The driver of the car was killed; the driver of the truck was not injured. The damage was estimated to cost $7 million. At the time of the accident, the weather was clear and dry with no overcast.[1]

The National Transportation Safety Board determines that the probable cause of the accident was the failure of the car driver to (1) stop for the red light or (2) reduce his speed or (3) apply his brakes soon enough to avoid the collision. Contributing to the severity of the accident was the fire resulting from the release of gasoline that the cargo tank's loading lines were carrying, as permitted by the DOT.

While investigating the accident, the Safety Board found that the accident's most significant element was not its cause, but its severity. A similar error on the part of a car driver might have had far less serious consequences—such as some damage to the car and truck, slight injuries, or both. In this case, however, one person died and the property damage was substantial. The crucial difference was the presence of gasoline in the loading lines.

Most MC-306 and DOT-406 cargo tanks used to transport petroleum distillate fuels are loaded through bottom loading lines and then operated on the roads with cargo in these lines.

[1]For more information, read Highway Accident Report—*Collision of Tractor/Cargo Tank Semitrailer and Passenger Vehicle and Subsequent Fire, Yonkers, New York, October 9, 1997* (NTSB/HAR-98/01/SUM).

However, because of their design, location, and vulnerability to being hit by other vehicles on the road, the practice of transporting hazardous materials in loading lines significantly increases the potential seriousness of any accident because cargo may be released from the damaged lines.

Safety Board investigators demonstrated the vulnerability of loading lines by placing 12 passenger vehicles (varying in type and size) near the loading lines of a cargo tank that was similar to the accident cargo tank. Each vehicle was placed so that the angle between it and the truck was approximately the same as the angle between the accident car and the accident truck. The investigators found that each of the 12 vehicles would have struck the loading lines of the truck had the vehicle moved forward. Therefore, the Safety Board believes that most vehicles currently in use are capable of striking the loading lines of cargo tanks.

In 1978, a FHWA memorandum established the FHWA policy of allowing gasoline to be carried in loading lines because of "economic and practicality considerations."

When RSPA published its final rule in 1989, which allowed the transportation of gasoline in loading lines, RSPA noted that loading lines are not appropriate packaging for hazardous materials:

> Bottom loading and unloading outlets on cargo tanks, although very useful, present the inherent risk that if damaged the entire contents of the tank may be released....piping attached to the outlet valve is provided with a sacrificial device that is designed to break under accident loads.... Because such piping under the current regulation is not specifically a part of the product containment vessel and is designed to fail in an accident, RSPA's position is that piping between the tank outlet valve and any loading valves is not an appropriate packaging for the transportation of hazardous materials.
>
> As a part of the implementation of the Clean Air Act (CAA), the Environmental Protection Agency (EPA) required that cargo tanks used in areas operating under EPA's State Implementation Plan for the CAA must be equipped with a vapor recovery system. The petroleum industry chose to use bottom loading in conjunction with tank top vapor recovery as their method of compliance with the CAA. All motor fuels must be metered for tax purposes. Unfortunately, in implementing this system the industry did not provide for a way to drain product from the cargo tank piping back into the loading facility and maintain proper accounting for tax purposes. As a result, cargo tanks are currently operated with gasoline in external piping that is designed to fail in an accident. The operation of cargo tanks with lading retained in external piping is generally limited to petroleum distillate fuels metered for road fuel tax purposes and transported in bottom loaded MC-306 type cargo tanks. The scope of these operations encompasses the vast majority of all gasoline transported.
>
> RSPA strongly believes the practice of transporting hazardous materials in exposed unprotected piping designed to fail, if impacted in an accident, is an unnecessary risk....Accordingly, RSPA proposed in the Notice for Proposed

> Rulemaking a prohibition on the transportation of hazardous materials in external piping unless the piping is protected by very substantial guards.
>
> Commenters for the petroleum industry, represented by the American Petroleum Institute and several large petroleum companies, argued that the need for bottom damage protection structures to protect piping containing lading is not justified. They argued that, based on statistical data showing the infrequency of accidents involving these lines, the relatively small amounts of product exposed, and the integrity and operation of current self-closing valves, the loss of lading from piping is not a significant problem.
>
> RSPA agrees that accidents resulting in damage to unprotected external piping carrying lading are infrequent, but the consequences of such accidents can be substantial, particularly if the material released has inherent hazards greater than that of gasoline....with the exception of gasoline, the transportation of hazardous materials in external unprotected piping is prohibited. For hazardous materials other than gasoline, transportation in external unprotected piping is less common and thus the prohibition of such transportation will have a much lower cost impact. However, if the transportation of gasoline in external unprotected piping were prohibited, the impact on the petroleum industry could be substantial.
>
> Although we have very serious concerns with the practice of transporting gasoline in external unprotected piping, we do not have sufficient data regarding incidents that can be attributed to the dislodging of piping to justify prohibiting the practice for gasoline at this time. Nor do we have adequate information concerning possible alternative procedures or equipment for accomplishing vapor recovery and road fuel tax metering and the costs associated with these alternatives. Many of the potential cost effective ways to eliminate the risk associated with the transportation of gasoline in external unprotected line may entail alterations to the cargo tank piping, fixed loading and unloading equipment, or both. For these reasons we are excepting gasoline from the prohibition on the transportation of hazardous materials in external unprotected piping. However, we encourage the petroleum industry to consider the risk they accept in employing this practice, and work to eliminate it. We believe the petroleum industry is best positioned to consider and evaluate all the possible ways to eliminate this risk in the most cost effective manner.

Subsequently, in 1990, after being petitioned by industry, RSPA amended the regulations to require bottom damage protection only for loading lines used to transport poison B liquids, oxidizer liquids, liquid organic peroxides, and liquids corrosive to the skin. The rulemaking permitted carriers to continue to transport petroleum products and other hazardous materials in loading lines without bottom damage protection.

The Safety Board concludes that transporting hazardous materials in loading lines creates a hazardous condition. Consequently, the Safety Board believes that the DOT should prohibit carrying hazardous materials in vulnerable piping, such as loading lines, of cargo tanks.

Therefore the National Transportation Safety Board issues the following recommendation to the U.S. Secretary of Transportation:

> Prohibit the carrying of hazardous materials in external piping of cargo tanks, such as loading lines, that may be vulnerable to failure in an accident. (H-98-27)

Please refer to Safety Recommendation H-98-27 in your reply. If you need additional information, you may call (202) 314-6445.

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in this recommendation.

By: Jim Hall
Chairman

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: May 21, 1998
In reply refer to: M-98-31 through -41

Admiral Robert Kramek
Commandant
U.S. Coast Guard
Washington, D.C. 20593-0001

Early on July 27, 1996, while the Panamanian cruise ship *Universe Explorer* was en route from Juneau, Alaska, to Glacier Bay, Alaska, with 1,006 people aboard, a fire started in the main laundry near an open fire door next to a stairway. Dense smoke and heat spread upward to a deck on which crew accommodation quarters were located. Five crewmembers died from smoke inhalation and 55 crewmembers and 1 passenger sustained minor or serious injuries. Sixty-nine people were transported to area hospitals, where 13 of the injured were admitted for further treatment.[1] The total estimated damage to the vessel was $1.5 million. As a result of its investigation of this fire, the National Transportation Safety Board identified several safety deficiencies, which are listed below. The analysis also raised questions about the toxicological testing criteria, namely the lack of specificity in the *Code of Federal Regulations* (CFR).

The major safety issues identified in this accident were, in part, the following:

- Adequacy of shipboard communications;
- Adequacy of fire prevention, detection, and control measures;
- Adequacy of company emergency procedures; and
- Adequacy of oversight, including the control verification examination (CVE) procedures of the Coast Guard.

In this accident, when the watch officer on the bridge received the first fire alarm, he immediately instructed the fire watch to verify the presence of a fire as required by company procedures. After the fire watch was below deck, the bridge watch officer radioed him a second time via UHF radio but heard no response, although the fire watch did receive and acknowledge the transmission using his UHF radio. When the fire watch realized that his radio transmissions were ineffective from his location, he tried to telephone the bridge with a report of smoke conditions, but the telephone line was busy. Upon hearing the announcement to report to emergency stations, the fire watch then went to his muster station, never reporting his observations to the watch officer on the bridge. Thus, the *Universe Explorer* suffered a

[1]For additional information, refer to Marine Accident Report—*Fire On Board the Panamanian Passenger Ship* Universe Explorer *in the Lynn Canal Near Juneau, Alaska, July 27, 1996 (NTSB/MAR-98/02).*

communications breakdown during the early phase of this emergency, not only because the type of instrument used was ineffective, but also because the fire watch did not follow effective procedures, failing to pass on essential information to the bridge.

The *Universe Explorer* is typical of passenger vessels whose steel structure results in "dead spots" where UHF radios become ineffective. Had the fire watch, who was acting alone, been seriously injured or trapped and in need of assistance, he could not have notified the bridge. Additionally, had he had vital information about the progress of the smoke, the fire, or the safety of people on board, he could not have transmitted it to the bridge. The Safety Board therefore found that the UHF radio did not provide the communications capability to ensure the safety of the fire watch, which, in turn, was needed to ensure the safety of passengers and crewmembers.

The Safety Board is aware that the U.S. Navy has addressed the problem of effective internal shipboard radio communications by installing an internal radio antenna network throughout its vessels. This type of system eliminates dead spots, enabling crewmembers to carry out communications with no interruptions. In the Board's opinion, it is absolutely essential that personnel who may be going into harm's way be able to receive and transmit messages from anywhere inside a vessel during an emergency.

The fire occurred immediately below the hospital, forcing the ship's doctor and nurses to evacuate immediately. The *Universe Explorer* medical staff had only one radio, which meant that the nurses repeatedly had to go to the doctor to determine where their assistance was most needed. The lack of effective communications interfered with the medical staff's ability to render treatment to injured passengers and crewmembers. Had each member of the medical staff had a radio and a separate frequency on which to communicate so as not to interrupt other emergency transmissions, the doctor and nurses could have conferred over the radio without having to leave patients; as a result, many injury victims could have been treated sooner.

Because the first fire alarm was triggered by a heat detector, smoke from the main laundry fire on the *Universe Explorer* probably began spreading upward to the crew berthing area before the bridge received the first alarm. The delay in the bridge watch's closing the magnetic fire doors in combination with the crew's compromising the effectiveness of some fire doors by tying them open allowed a massive, lethal amount of smoke to quickly accumulate in the crew accommodations area, trapping a number of crewmen in their quarters. Their cabins lacked telephones or other means of communication with which they could signal their location or call for help. Crewmen tried to signal their need for assistance by waving a towel out of a porthole, by banging on walls, and by yelling for help; however, their efforts were ineffective. Because of the vessel's steel construction, noises either migrated or were not audible, making it difficult for rescuers to accurately determine where the trapped crewmen were located. Rescuers did not find several trapped crewmen until more than 2 ½ hours after the fire started. Had some stranded crewmen not found a room with a porthole, the number of fatalities would have been higher.

The Safety Board has been a proponent of emergency call systems in passenger staterooms on cruise ships for several years; in a 1993 special investigation report[2] concerning passenger ship accidents, the Board issued Safety Recommendation M-93-39 asking that the Coast Guard "analyze the desirability and feasibility of equipping passenger staterooms with an emergency call system by which trapped passengers can signal their plight." The Coast Guard ultimately advised the Safety Board on August 6, 1996, that it had discussed the desirability and feasibility of installing emergency call systems in passenger staterooms with the U.S. Safety of Life At Sea (SOLAS) Working Group on Fire Protection and, based upon that discussion, determined that "an additional emergency call system would not improve passenger-to-crew communications and would require additional maintenance." The Safety Board then classified Safety Recommendation M-93-39 "Closed—Unacceptable Action" because the Coast Guard did not perform the requested analysis.

As mentioned earlier, when the fire watch tried to contact the bridge by telephone, he got a busy signal. The Safety Board notes that the *Universe Explorer* had telephones in passenger staterooms. Had passengers been trapped and tried to use their telephones, they likely would have had similar difficulties. As this accident demonstrates, all accommodation areas should have a means by which individuals can signal their locations during a fire emergency to facilitate rescue operations. Even a simple system, such as the flight attendant call button system used on commercial airlines, would probably be sufficient to signal a location.

A number of factors adversely affected survivability on this ship. During the Safety Board's postaccident examination of the laundry, investigators observed that a bulkhead isolating the laundry area from the stair towers had been removed. The presence of the bulkhead would not have prevented a fire from starting; however, it would have mitigated the propagation of smoke, thereby affording the crew a better chance for survival.

Records show that the vessel now known as the *Universe Explorer* was built in 1958 as a combination passenger/cargo ship, has been owned by a number of companies, and has undergone a number of major modifications. The present vessel operator indicated that the main laundry bulkhead was removed with the approval of the American Bureau of Shipping (ABS) during a conversion completed in the early 1970s while the vessel was being operated by another company. However, classification and inspection authorities have no record of granting approval for removal of this bulkhead.

This accident therefore raises questions about the adequacy of the ABS survey and Coast Guard control verification procedures and the resulting thoroughness of their inspections. According to Coast Guard documents, its inspectors currently check a foreign-registered passenger vessel's approved plans when the vessel first enters service in the United States or when it undergoes a major structural modification. In the case of the *Universe Explorer*, the vessel happened to first enter U.S. service as a foreign passenger ship during a 5-year period when the Coast Guard did not require a plan review as part of the initial CVE.

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[2]For additional information, read Special Investigation Report—*Accidents Involving Foreign Passenger Ships Operating from U.S. Ports 1990-1991* (NTSB/SIR-93/01).

Since the late 1980s, the Coast Guard regularly conducted annual and quarterly CVEs of the *Universe Explorer*. The Coast Guard's *Navigation and Vessel Inspection Circular No. 1-93* does not specifically describe how and to what extent inspectors should check fire boundaries. For example, instructions for the quarterly CVE state that the extent of the vessel examination is "at the discretion of the attending inspectors" and is determined by the observed condition of the ship. Instructions for a general walk-through stipulate only that the inspectors should check the engine room, machinery spaces, and accommodation spaces.

On July 20, 1996, one week before the fatal fire, Coast Guard inspectors conducted a quarterly CVE during which they held a fire drill in the main laundry, yet they did not notice that the bulkhead shown on the fire control plan was not in place. This raises the question of whether the inspectors even referred to the plan in the course of conducting the drill. The Safety Board concluded that the Coast Guard plan review and examination procedures of foreign passenger vessels do not adequately address the need to verify structural fire protection boundaries. What particularly disturbs the Safety Board about the missing bulkhead is that it was shown as being in place on the fire control plan, a document that is critical for firefighting. This case therefore highlights the need for the Coast Guard to periodically verify that vessels are maintained in accordance with approved plans as part of the agency's CVE program.

When Safety Board investigators examined the main laundry after the fire, they noted that the smoke detectors were not connected to the fire detection system. The only active fire detection devices in the area were heat detectors. Records do not indicate why the smoke detectors were disconnected. However, from discussions with people experienced in laundry operations, fire experts, and detector manufacturers, the Safety Board determined that moisture, dust, and lint in the air of a laundry facility can trigger smoke detector sensors, resulting in false alarms, unless the devices are maintained appropriately. Heat-actuated detectors require more time than smoke detectors to actuate because a minimum level or minimum rate of heating must occur in the area of the device's sensor before the detector activates. The limitations of each type of detector could be reduced by establishing systems using both types of devices. Moreover, combining the system of detection with an automatic sprinkler system would provide a greater measure of safety by limiting the spread of fire.

The Safety Board is aware of present methods for verifying the reliability of fire alarms, such as cross zoning, and of detection systems that are in development, such as infrared or ultraviolet detectors. Given the high fire risk of laundry spaces, it is essential that ship owners and operators be made aware of reliable ways for monitoring such areas.

Records indicate that on the morning of the accident, all fire doors were closed within a few minutes of the first fire alarm. Nevertheless, soot and debris patterns observed during the postaccident examination indicated that the fire doors, while open, had allowed the smoke and heat from the fire to enter the stairway, which then served as a flue, transmitting smoke and hot gases upward to other decks. At the top of the stairway, the open fire door allowed massive quantities of smoke to enter the break no. 1 passageway and migrate into the crew berthing area.

Had the doors leading from the main laundry to the stairways automatically closed when the fire started, the smoke and heat of the fire probably would have been contained within the boundaries of the main laundry long enough for crewmembers to have been warned of the fire and to have escaped from their berthing area. The Safety Board concluded that had automatic closure of the fire doors been incorporated in the fire detection system, the fire doors in the area where the fire broke out would have shut immediately when nearby detectors activated, thereby restricting the spread of lethal amounts of smoke to the crew berthing areas.

The Board identified the need for automatic closure of fire doors long before this incident. As a result of its investigation of the August 20, 1984, fire on board the Bahamian passenger ship *Scandinavian Sun*,[3] the Safety Board issued safety recommendations asking that the Coast Guard propose to the International Maritime Organization (IMO) that SOLAS 74 be amended to require the integration of fire detectors with fire doors (M-85-60) and the fire control system (M-85-61). The Coast Guard concurred and submitted the proposals at the February 1986 meeting of the IMO Fire Protection Subcommittee, which took no action on them.

In a 1989 safety study,[4] the Safety Board superseded Safety Recommendations M-85-60 and -61 with Safety Recommendations M-89-124 and -125, asking the Coast Guard to propose that the IMO, in part, require passenger ships operating from U.S. ports and embarking U.S. passengers to have a centralized automatic/manual fire control system integrating the fire detector, automatic fire door controls, ventilation systems controls, and general alarm into a unified system (M-89-124) and integrated heat and/or smoke detectors with automatic fire door release switches (M-89-125).

In 1992, the IMO enacted amendments to the SOLAS 74 fire safety regulations that included improved measures for fire doors. Requirements contained in Chapter II-2 stipulate that new passenger ships must have fire doors capable of remote and automatic release from a continuously staffed central control station, as well as from a position at both sides of each individual door. Further, SOLAS Regulation 41-2 requires that the stairway enclosures, main vertical zone bulkheads, and galley boundaries on existing passenger vessels be fitted with self-closing fire doors capable of being released from a central control station and from each door.

The Safety Board reviewed the amendments to SOLAS 74, considered the measure requiring remote release from a centrally manned location to be in compliance with the intent of the recommendations, and classified Safety Recommendations M-89-124 and -125 "Closed—Acceptable Alternate Action." Following its investigation of the *Universe Explorer* fire, the Board has reconsidered its opinion. As this accident demonstrates, having a central station initiate the closure of fire doors does not afford the maximum measure of safety and can result in delays that prove fatal.

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[3]For additional information, read Marine Accident Report *Fire Onboard the Bahamian Passenger Ship* M/V Scandinavian Sun, *Port of Miami, Miami, Florida, August 20, 1984* (NTSB/MAR-85/08).

[4]For additional information, read Safety Study—*Passenger Vessels Operating from U.S. Ports* (NTSB/SS-89/01).

Based upon interviews with crewmembers, the Safety Board identified several deficiencies in the on-board emergency procedures, including the adequacy of the crew emergency drills and the methods used to locate the fire and trapped crewmembers.

The *Universe Explorer* conducted weekly crew emergency drills as required by SOLAS. The drills did not include, and were not required to include, identifying alternate escape routes from cabins and work sites. The berthing area where the fatalities occurred was forward of the crew galley and most work areas. Consequently, when crewmembers were alerted to the fire, they reacted according to habit in attempting to escape. They first tried to walk aft but could not continue because the increasing intensity of the heat and smoke forced them to turn around to find alternative escape routes. Although they had several other means of escape 50 to 60 feet away, locating an exit quickly in the dense smoke conditions was difficult. The position of the deceased crewmen's bodies in the passageways indicates that they probably were overcome by the heavy, toxic smoke while trying to find an escape route.

The 1995 amendments to the Standards for Training Certification and Watchkeeping Convention that became effective February 1, 1997, recognize the need for improved survival training. The amendments require that before being assigned to shipboard duties, crewmembers who are new to a seagoing ship must receive familiarization training in survival techniques or receive sufficient information and instructions to be able to perform certain tasks, including identifying emergency escape routes and muster and embarkation stations. Although the Safety Board is pleased by the training requirements for new employees, it is concerned that individuals newly assigned to a ship, who have to familiarize themselves with numerous other vessel operations, may not assimilate all or may forget some of the information provided to them. Based on its findings from this accident, the Safety Board determined that crewmembers need periodic training in survivability that includes information and/or drills about alternate routes of escape.

Following the emergency broadcast to the crew, the ship's two fire teams assembled, donned protective gear, and marshaled firefighting equipment. The safety officer took charge of the search for the fire while the staff captain directed efforts to search the crew berthing area. Despite the prompt action, the searches did not result in timely location of either the fire or the trapped crewmen.

The search for the trapped crewmembers was disorganized and ineffective. The staff captain initially directed one fire team member to don breathing equipment and to search the crew area alone, which was ill-advised and dangerous. The lone searcher encountered fallen crewmen whom he could not aid and heard calls for help from people whom he could not locate. He reported his findings to the staff captain, who, along with another team member, went below deck with the first searcher to remove the fallen crewmen. However, the staff captain did not immediately order other fire team members to find the trapped crewmen. The lack of systematic effort and the delay in rescuing trapped crewmembers demonstrate that the *Universe Explorer* crew was not adequately prepared to conduct rescue operations. The Safety Board concluded that if the vessel had had a properly equipped rescue team that was trained in locating and recovering people trapped in smoke-filled areas, the crewmen probably would have been rescued sooner and would have sustained less severe injuries; moreover, fewer crewmen may have died.

In addition to the major safety issues discussed above, the Safety Board had concerns about the toxicological testing that warrant discussion. Following this accident, company officials did not designate any crewmember for testing until late July 27, 1996, and only then at the request of Safety Board investigators. Specimens were not collected from the individuals designated for testing until at least 34 hours after the accident. Crewmembers who were tested showed no indication of having used drugs or alcohol. In this case, however, the fire watch, who was known to have been in the main laundry within 20 minutes of a fire detector activating in the area, was not tested for either drugs or alcohol.

In reviewing the regulatory requirements for testing, the Safety Board found that the wording in the CFR regarding who should undergo postaccident toxicological testing is not specific. The regulations at 46 CFR Subpart 4.06 state that following a serious marine incident "the marine employer shall take all practicable steps to have each individual engaged or employed on board a vessel who is directly involved in the incident chemically tested for evidence of drug and alcohol use" and to ensure that specimens are collected "as soon as practicable." The term *individual directly involved in a serious marine incident* is defined at 46 CFR subpart 4.03-4 as "an individual whose order, action or failure to act is determined to be, or cannot be ruled out as, a causative factor in the events leading to or causing a serious marine incident." The Safety Board found that, in the absence of specific criteria, an immediate determination of the individual(s) directly involved in a serious marine incident who should be considered for drug and alcohol testing is sometimes difficult and that procedures are needed to ensure that such identification and subsequent testing is conducted in a timely manner.

Therefore, the National Transportation Safety Board recommends that the U.S. Coast Guard:

> Propose to the International Maritime Organization that passenger ships be required to institute procedures, upgrade equipment, or do both to establish reliable internal radio communications from anywhere inside a vessel during an emergency. (M-98-31)
>
> Recommend to the International Maritime Organization that passenger and crew cabins on cruise ships be required to be equipped with an emergency call system so that people trapped during a fire emergency may have a means of signaling their location. (M-98-32)
>
> Conduct research with the passenger ship industry and the National Fire Protection Association on the adequacy of heat and smoke detectors for use in high-fire-risk areas, including laundry spaces, of passenger ships and, based upon your findings, propose to the International Maritime Organization equipment or procedural guidelines for improving the reliability of fire alarms. (M-98-33)
>
> Propose to the International Maritime Organization that passenger ships be required to integrate heat and/or smoke detectors with automatic fire door release switches so that the doors in the immediate area of the fire will close automatically when the detectors are activated. (M-98-34)

Propose to the International Maritime Organization that periodic instruction or drills on alternate escape routes be provided to all crewmembers on passenger ships to reinforce the familiarization training required of new seafarers by the 1995 Amendments to the Standards for Training Certification and Watchkeeping Convention. (M-98-35)

Propose to the International Maritime Organization that specially trained and suitably equipped rescue teams be required on board all passenger ships. (M-98-36)

Recommend to the International Maritime Organization that passenger ship companies be required to equip each on-board medical staff member with a portable radio with a dedicated frequency for use during an emergency. (M-98-37)

Revise your control verification examination procedures to include a more detailed review of structural fire protection features on board foreign passenger ships. (M-98-38)

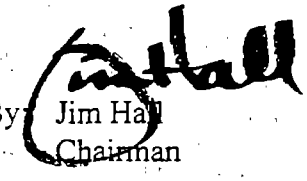
Require that each foreign passenger vessel operating from U.S. ports periodically undergo a complete plan review and vessel examination to verify that it is being maintained in accordance with approved plans. (M-98-39)

In cooperation with maritime industry representatives, establish criteria for identifying those individuals who should undergo drug and alcohol testing after a serious marine incident, and establish procedures to ensure that such identification and subsequent testing is conducted in a timely manner. (M-98-40)

Submit a copy of the National Transportation Safety Board's report of the fire on board the *Universe Explorer* to the International Maritime Organization for distribution and discussion. (M-98-41)

Also, the Safety Board issued Safety Recommendations M-98-42 through -57 to New Commodore Cruise Line, Ltd., and to V. Ships Marine, Ltd., M-98-58 through -67 to the International Council of Cruise Lines, and M-98-68 to the American Bureau of Shipping.

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in these recommendations.



By: Jim Hall
Chairman

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: May 21, 1998
In reply refer to: M-98-42 through -57

Mr. James Sullivan
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Mr. Thomas F. Keenan
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22 Jericho Turnpike
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Early on July 27, 1996, while the Panamanian cruise ship *Universe Explorer* was en route from Juneau, Alaska, to Glacier Bay, Alaska, with 1,006 people aboard, a fire started in the main laundry near an open fire door next to a stairway. Dense smoke and heat spread upward to a deck on which crew accommodation quarters were located. Five crewmembers died from smoke inhalation and 55 crewmembers and 1 passenger sustained minor or serious injuries. Sixty-nine people were transported to area hospitals, where 13 of the injured were admitted for further treatment.[1] The estimated total damage to the ship was $1.5 million.

In this accident, when the watch officer on the bridge received the first fire alarm, he immediately instructed the fire watch to verify the presence of a fire as required by company procedures. After the fire watch was below deck, the bridge watch officer radioed him a second time via UHF radio but heard no response, although the fire watch did receive and acknowledge the transmission using his UHF radio. When the fire watch realized that his radio transmissions were ineffective from his location, he tried to telephone the bridge with a report of smoke conditions, but the telephone line was busy. Upon hearing the announcement to report to emergency stations, the fire watch then went to his muster station, never reporting his observations to the watch officer on the bridge. Thus, the *Universe Explorer* suffered a communications breakdown during the early phase of this emergency, not only because the type of instrument used was ineffective, but also because the bridge watch and the fire watch did not follow effective procedures.

[1]For additional information, refer to Marine Accident Report—*Fire On Board the Panamanian Passenger Ship* Universe Explorer *in the Lynn Canal Near Juneau, Alaska, July 27, 1996 (NTSB/MAR-98/02).*

The *Universe Explorer* is typical of passenger vessels whose steel structure results in "dead spots" where UHF radios become ineffective. In an emergency situation, it is absolutely essential that personnel who may be going into harm's way be able to receive and transmit messages. Had the fire watch, who was acting alone, been seriously injured or trapped and in need of assistance, he could not have notified the bridge. Additionally, had he had vital information about the progress of the smoke, the fire, the safety of the crew, or the safety of the passengers, he could not have transmitted it to the bridge. In this accident case, the National Transportation Safety Board concluded that the UHF radio did not provide the communications capability to ensure the safety of the fire watch, which, in turn, was needed to ensure the safety of the passengers and the crew. The Board determined that had the *Universe Explorer* been equipped with an internal radio antenna network, which eliminates dead spots, radio communications would have been more effective during the emergency.

During this emergency, when the second officer received no response to his transmissions, he did not initiate measures to determine what had happened to the fire watch. For his part, the fire watch did not advise the bridge about his status or the conditions on the Main deck and left his fire patrol post without first communicating with and obtaining permission from the watch officer. The Safety Board determined that internal communication procedures used during shipboard emergency responses, particularly the communication between the bridge watch and fire watch when the latter is sent to investigate a fire alarm, need to be improved.

The fire occurred immediately below the hospital, forcing the ship's doctor and nurses to evacuate immediately. The *Universe Explorer* medical staff had only one radio, which meant that the nurses repeatedly had to go to the doctor to determine where their assistance was most needed. The lack of effective communications interfered with the medical staff's ability to render treatment to injured passengers and crewmembers. Had each member of the medical staff had a radio and a separate frequency on which to communicate so as not to interrupt other emergency transmissions, the doctor and nurses could have conferred over the radio without having to leave patients; as a result, many injury victims could have been treated sooner.

Fire conditions prevented the medical staff from accessing the medical supplies stored in the hospital. The bridge maintained an emergency medical kit, but it did not contain oxygen to treat the crewmembers who sustained smoke inhalation injuries. The Safety Board determined that the circumstances of this accident point out that the *Universe Explorer* should have an auxiliary store of medical equipment and medicine for use in emergencies should the hospital become inaccessible.

Smoke from the main laundry fire on the *Universe Explorer* probably began spreading upward to the crew accommodations area before the bridge received the first fire alarm. Because of the delay in the bridge watch's closing the magnetic fire doors and because crewmembers compromised the effectiveness of some fire doors by tying them open, a massive, lethal amount of smoke quickly accumulated in the crew accommodations area, trapping a number of crewmen.

The method I construction used in building the *Universe Explorer* is designed to confine a fire to its compartment of origin by the use of structural fire boundaries. Fire screen doors are

an important feature of these fire boundaries because they maintain the fire integrity when closed. In the Board's view, closing the fire doors ought to be the first action taken on a method I ship when a fire alarm activates. To do otherwise allows more time for the heat and smoke of a fire to escape from its compartment of origin and to spread to other parts of the vessel. In this instance, the first alarm sounded at 0259, and the doors were not closed until 0305. If the watch officer had immediately closed the fire doors when the bridge received the first fire alarm, the amount of smoke that ultimately reached the crew berthing area may have been significantly reduced. The Safety Board concluded that the *Universe Explorer*'s operating procedures that the watch officer is supposed to follow when a fire alarm activates are less than adequate to ensure the timely establishment of fire boundaries restricting the spread of heat and smoke.

However, in this case, even if the bridge watch had closed all doors when he received the first alarm, conditions still might have been perilous because the main laundry was fitted with heat detectors instead of smoke detectors, the fire was next to the stairwell, and the doors to the crew berthing corridors were tied open. Together, these factors contributed to a rapid spread of smoke before the first heat detector actuated. Therefore, the nature of this fire demonstrates that having a central station initiate the closure of fire doors does not afford the maximum measure of safety and can result in delays that prove fatal.

Had the fire doors leading from the main laundry to the stairways automatically closed when the fire started, the smoke and heat of the fire would probably have been contained within the boundaries of the main laundry long enough for crewmembers to have been warned of the fire and to have escaped from their berthing area. The Safety Board concluded that had automatic closure of the fire doors been incorporated in the fire detection system of the *Universe Explorer*, the doors near the fire would have shut immediately when nearby detectors activated, thereby restricting the spread of lethal amounts of smoke to the crew berthing areas.

The crew cabins lacked telephones or other means of communication with which they could signal their location or call for help. Crewmen tried to signal their need for assistance by waving a towel out of a porthole, by banging on walls, and by yelling for help; however, their efforts were ineffective. Because of the steel construction of the vessel, noises either migrated or were not audible, making it difficult for rescuers to accurately determine where trapped crewmembers were located. Rescuers did not locate several trapped crewmen until more than 2 ½ hours after the fire started. Had some stranded crewmen not found a room with a porthole, the number of fatalities would have been higher. However, had they had a means, such as an emergency call system similar to the flight attendant call system used on commercial airlines, by which they could signal their location, rescuers could have determined that location and helped them sooner, thereby reducing the number and severity of injuries to the trapped crewmen and exposing the search teams to fewer risks.

Other factors adversely affected fire detection and control on the *Universe Explorer*. At the time of this accident, the main laundry on the *Universe Explorer* was not equipped with, and was not required by the *Safety of Life at Sea* (SOLAS) Convention to have, an automatic fire sprinkler system. In this fire a tremendous, lethal amount of smoke was produced when the many layers of paint on the stairwell bulkheads ignited. If the main laundry of the *Universe Explorer*

had been equipped with automatic sprinklers, they probably would have activated and extinguished the fire during its early development, preventing or at least mitigating the spread of smoke and flames into the spiral stairway. The Safety Board concluded that if the *Universe Explorer* had been equipped with an automatic sprinkler system, the large quantities of smoke and resulting loss of life may have been avoided.

When Safety Board investigators examined the main laundry after the fire, they noted that the smoke detectors were not connected to the fire detection system. The only active fire detection devices in the area were heat detectors. Records do not indicate why the smoke detectors were disconnected. However, from discussions with people experienced in laundry operations, fire experts, and detector manufacturers, the Safety Board determined that moisture, dust, and lint in the air of a laundry facility can trigger smoke detector sensors, resulting in false alarms, unless the devices are maintained appropriately. Heat-actuated detectors require more time than smoke detectors to actuate because a minimum level or minimum rate of heating must occur in the area of the device's sensor before the detector activates. The limitations of each type of detector could be reduced by establishing systems using both types of devices. Moreover, combining the system of detection with an automatic sprinkler system would provide a greater measure of safety by limiting the spread of fire. Based on its findings, the Safety Board concluded that greater fire protection can be attained in laundry facilities by using a combination of different types of detection devices, as well as an automatic suppression system.

The Safety Board is aware of other fire detection systems that are in development, including infrared and ultraviolet flame detectors and carbon monoxide detection systems. Some of these systems are currently available, and others are still being tested. Investigative research at the National Fire Academy has shown that using an alarm verification reset feature and cross zoning of fire detectors significantly reduce random false alarms and increase the reliability of fire detectors.

Given the high fire risk in laundry operations, improvements in the methods used to monitor such areas are essential. Conventional fire surveillance consists mainly of smoke and heat detectors. However, other methods are available that could augment passive sensory devices. Safety aboard the *Universe Explorer* could also be improved by instituting improved surveillance measures, such as installing video cameras in high-fire-risk areas.

One of the specific duties assigned to the fire watch was to ensure that all fire screen doors were not blocked or lashed open. Soot deposits and remnants of twine indicated that some fire screen doors were lashed open during the fire. The Safety Board therefore determined that the fire watch's execution of assigned duties and the safety officer's oversight of the fire watch were less than adequate and need to be improved.

Based on surveys of passengers and interviews with crewmembers, the Safety Board identified some deficiencies in on-board emergency procedures.

Some survey respondents stated that the passenger fire drill consisted of providing them with instructions on how to don a life preserver and on how to locate their muster stations. A large majority of those responding indicated that passengers were not told what to do should they

see a fire or smell smoke. Passengers were particularly critical of the lack of information provided about the fire doors. About one-fourth of the responders characterized the drill as unrealistic because many passengers who knew the scheduled time of the drill went in advance to their lifeboats, using the elevators to reach their stations. One passenger complained that the drill did not prepare him to locate his life preserver because it had been placed on his bunk for the drill when he first arrived at his stateroom, whereas it was stowed in his room when he needed it during the actual emergency.

To have the maximum effectiveness, fire drills should be as realistic as possible. The content of the drill on the *Universe Explorer* left many passengers unprepared to meet the demands of the actual fire emergency. Allowing passengers to use elevators to reach their assembly stations during a drill does not prepare them to identify a safe route of escape. Further, not requiring passengers to observe approved safety procedures during drills may lead them to attempt the same shortcuts during the actual emergency, perhaps with tragic results. When dealing with a large group—in this case, 732 passengers—undoubtedly some individuals will become agitated or frightened during an actual emergency. When events occur for which passengers are not prepared, such as magnetic doors suddenly slamming shut, the likelihood increases that they will panic. Such reactions clearly support the need for passenger fire drills and for placards in staterooms that contain adequate instructions about fire emergencies. To be effective, a drill must provide passengers with the basic information, including:

- how to report a fire;
- what to expect if a fire occurs, such as typical announcements, actions of the crew, operation of the emergency lights, and operation of fire doors;
- the location and meaning of emergency signs;
- the description of emergency signals;
- if incapacitated, how to call for assistance; and
- the route to take from their stateroom to their assembly area.

Passengers indicated that they were not adequately informed about the progress of the emergency while they were at their muster stations, although announcements were made over the public address system asking them to remain calm. They said they were never told how long they might have to remain at the assembly areas. Further, they felt that someone in authority, such as the master or another officer, should have given them status updates. One passenger stated, "There was no communication from the ship's captain or any officer of the crew until several passengers challenged an official from the cruise line to inform us of the situation, 4 to 5 hours after the initial fire."

During an emergency, it is vital to passengers' peace of mind to receive periodic information about the status of the situation, particularly any progress in overcoming a threat to safety. Further, receiving such reports from a recognized authority figure, such as the ship's master, is more reassuring. Understandably, the master's and officers' primary concern was to

extinguish the fire. Nonetheless, providing periodic assurances to passengers during prolonged emergencies is important so that order and discipline can be maintained.

The *Universe Explorer* conducted weekly crew emergency drills as required by SOLAS. The drills did not include, and were not required to include, identifying alternate escape routes from cabins and work sites. The berthing area where the fatalities occurred was forward of the crew galley and most work areas. Consequently, when crewmembers were alerted to the fire, they reacted according to habit in attempting to escape. They first tried to walk aft but could not continue because the increasing intensity of the heat and smoke forced them to turn around to find alternative escape routes. They said the heavy smoke stung their eyes and severely limited their visibility, requiring that they feel their way along the corridors until they found an exit. Although they had several other means of escape 50 to 60 feet away, locating an exit quickly was difficult. The position of the deceased crewmen's bodies in the passageways indicates that they probably were overcome by the heavy, toxic smoke while trying to find an escape route.

The 1995 amendments to the Standards for Training Certification and Watchkeeping Convention that became effective February 1, 1997, recognize the need for improved survival training. The amendments require that before being assigned to shipboard duties, crewmembers who are new to a seagoing ship must receive familiarization training in survival techniques or receive sufficient information and instructions to be able to perform certain tasks, including identifying emergency escape routes and muster and embarkation stations. Although the Safety Board is pleased by the training requirements for new employees, it is concerned that individuals newly assigned to a ship, who have to familiarize themselves with numerous other vessel operations, may not assimilate all or may forget some of the information provided to them. Based on its findings from this accident, the Safety Board determined that crewmembers need periodic training in survivability that includes information and/or drills about alternate routes of escape.

Following the emergency broadcast to the crew, the ship's two fire teams assembled, donned protective gear, and marshaled firefighting equipment. The safety officer took charge of the search for the fire while the staff captain directed efforts to search the crew berthing area. Despite the prompt action, the searches did not result in timely location of either the fire or the trapped crewmen.

The safety officer used a trial-and-error method, first alone and then with a fire team leader, to locate the fire. On the *Universe Explorer*, even the most stoutly constructed fire boundary is designed to prevent the passage of heat and smoke for only 60 minutes; therefore, timely location of a fire is paramount. Although ultimately successful, the men did not find the fire for 30 to 45 minutes. During this time, the fire continued to burn freely, producing increasing amounts of toxic smoke. Had the safety officer organized a more methodical approach, assigning one or more search teams to check out possible avenues simultaneously, the fire probably would have been located sooner.

The search effort to find the trapped crewmembers was also disorganized and ineffective. The staff captain directed one fire team member to don breathing equipment and search the crew area. The lone searcher said that he encountered intense and blinding smoke, saw the fallen

crewmembers, and heard people calling for help but saw nothing but smoke. He returned to the staging area, whereupon the staff captain directed a second team member to join the first searcher and return to remove the fallen crewmen. However, they did not immediately initiate follow-up actions to find the trapped crewmen.

Again, having a lone individual—in this case the fire team member—search an area of a vessel during a fire was ill-advised and dangerous. The searcher could have needed help himself or could have encountered people who needed assistance that was beyond the ability of one person to provide. The delay and lack of systematic effort in rescuing trapped crewmembers demonstrates that the *Universe Explorer* crew was not adequately prepared to conduct rescue operations. The Safety Board concluded that if the *Universe Explorer* had had a properly equipped rescue team that was trained in locating and recovering people trapped in smoke-filled areas, the crewmen probably would have been rescued sooner and would have sustained less severe injuries; moreover, fewer crewmen may have died.

As described in greater detail earlier in this letter, company policies and procedures were less than adequate in a number of areas, including emergency response procedures, employee oversight, communications equipment and procedures, fire drills, fire locating procedures, and search and rescue.

Company representatives indicated that shoreside officials periodically visit the ship to confer with vessel officers and attend classification society surveys and U.S. Coast Guard examinations. In the Board's opinion, these actions alone are not sufficient to provide adequate management oversight and to ensure effective fire safety aboard the vessel. These meetings typically exclude personnel who are not in upper shipboard management. Effective management oversight must extend beyond upper shipboard managers to include personnel from all levels in the shipboard organization. Only through inclusion may commitment to safety be attained at all levels of the shipboard organization. If more effective management oversight of safety had been exercised on the *Universe Explorer*, crewmembers would not have compromised the effectiveness of the fire doors by tying them open, the fire watch would have been more mindful that he needed to report his findings to the watch officer, and the watch officer would have been more concerned about the safety of the fire watch. The company needs to foster the attitude among crewmembers that fire safety is preeminent in vessel operations and that their actions directly affect the safe operation of the ship. Moreover, better oversight measures are needed to improve the level of fire safety on the *Universe Explorer*.

Therefore, the National Transportation Safety Board recommends that the New Commodore Cruise Lines, Ltd., and V. Ships Marine, Ltd.:

> Improve the means of radio communications between shipboard command and emergency responders and among emergency response groups on board your passenger ships. (M-98-42)
>
> Review and, if necessary, revise shipboard communication procedures to ensure that watch officers and the fire watch maintain effective communications at all times, especially when the fire watch enters a suspected fire area. (M-98-43)

Equip crew cabins on company passenger ships with an emergency call system so that people trapped in their cabins during a fire emergency can signal their location. (M-98-44)

Modify the fire control systems on company passenger vessels, integrating heat and/or smoke detectors with automatic fire door release switches. (M-98-45)

Provide each member of the medical staff on board company passenger ships with a portable radio for use in shipboard emergencies. (M-98-46)

Review the adequacy of the fire detection systems presently protecting high-fire-risk areas, including laundry spaces, on board company passenger ships, and, based on that review, install improved detection systems or institute improved surveillance procedures to improve fire detection capability. (M-98-47)

Implement procedures to improve the oversight of the fire watch on board company passenger ships. (M-98-48)

Review and revise as necessary the operating procedures followed by the navigation watch officer to ensure that fire screen doors are closed immediately upon receipt of a fire alarm. (M-98-49)

Revise passenger fire drills and stateroom placards to advise passengers what to expect in a fire emergency. Include an explanation that fire doors shut automatically and instructions for opening them. (M-98-50)

Revise procedures for announcing emergency status updates to passengers assembled at muster stations so as to assuage their concerns. (M-98-51)

Provide periodic instruction or drills on alternate escape routes to all crewmembers on company passenger vessels to reinforce the familiarization training required of new seafarers by the 1995 Amendments to the Standards for Training Certification and Watchkeeping Convention. (M-98-52)

Establish improved procedures for crewmembers to follow in locating fires on board company passenger ships. (M-98-53)

Establish for each company vessel a rescue team dedicated to locating trapped passengers and crew during a fire emergency, and provide the team members with recurrent search and rescue training. (M-98-54)

Review the contents of passenger vessel emergency medical kits to ensure they contain adequate medical supplies to meet an emergency, such as the fire on board the *Universe Explorer*. (M-98-55)

Address the safety issues identified in this report in the safety program that you are developing for compliance with the International Safety Management Code. Further, increase the shoreside management's oversight of fire safety conditions on board your vessels by initiating the following measures, at a minimum, periodic fire safety vessel examinations and periodic instruction for the ships' crews on maintaining a fire-safe vessel. (M-98-56)

Immediately install automatic sprinkler systems in accommodation areas, service areas, stairway enclosures, and corridors on company ships. (M-98-57)

Also, the Safety Board issued Safety Recommendations M-98-31 through -41 to the U.S. Coast Guard, M-98-58 through -67 to the International Council of Cruise Lines, and M-98-68 to the American Bureau of Shipping.

The National Transportation Safety Board is an independent Federal agency with the statutory responsibility "to promote transportation safety by conducting independent accident investigations and by formulating safety improvement recommendations" (Public Law 93-633). The Safety Board is interested in any action taken as a result of its safety recommendations. Therefore, it would appreciate a response from you regarding action taken or contemplated with respect to the recommendations in this letter. Please refer to Safety Recommendations M-98-42 through -57 in your reply. If you have any questions, you may call (202) 314-6455.

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in these recommendations.

By: Jim Hall
Chairman

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: May 21, 1998
In reply refer to: M-98-58 through -67

Ms. Cynthia A. Colenda
President
International Council of Cruise Lines
1211 Connecticut Avenue, N.W.
Suite 800
Washington, D.C. 20036

Early on July 27, 1996, while the Panamanian cruise ship *Universe Explorer* was en route from Juneau, Alaska, to Glacier Bay, Alaska, with 1,006 people aboard, a fire started in the main laundry near an open fire door next to a stairway. Dense smoke and heat spread upward to a deck on which crew accommodation quarters were located. Five crewmembers died from smoke inhalation and 55 crewmembers and 1 passenger sustained minor or serious injuries. Sixty-nine people were transported to area hospitals, where 13 of the injured were admitted for further treatment.[1] The estimated total damage to the ship was $1.5 million.

In this accident, when the watch officer on the bridge received the first fire alarm, he immediately radioed the fire watch to verify the presence of a fire as required by company procedures. After the fire watch was below deck, the bridge watch officer radioed him a second time via UHF radio but heard no response, although the fire watch did receive and acknowledge the transmission using his UHF radio. When the fire watch realized that his radio transmissions were ineffective from his location, he tried to telephone the bridge with a report of smoke conditions, but the telephone line was busy. Upon hearing the announcement to report to emergency stations, the fire watch then went to his muster station, never reporting his observations to the bridge. Thus, the *Universe Explorer* suffered a communications breakdown during the early phase of this emergency, not only because the type of instrument used was ineffective, but also because the fire watch did not follow effective procedures, failing to pass on essential information to the bridge.

The *Universe Explorer* is typical of passenger vessels whose steel structure results in "dead spots" where UHF radios become ineffective. In an emergency situation, it is absolutely essential that personnel who may be going into harm's way be able to receive and transmit messages. Had the fire watch, who was acting alone, been seriously injured or trapped and in need of assistance, he could not have notified the bridge. Additionally, had he had vital

[1]For additional information, refer to Marine Accident Report—*Fire On Board the Panamanian Passenger Ship* Universe Explorer *in the Lynn Canal Near Juneau, Alaska, July 27, 1996 (NTSB/MAR-98/02).*

information about the progress of the smoke, the fire, the safety of the crew, or the safety of the passengers, he could not have transmitted it to the bridge. In this accident case, the National Transportation Safety Board found that the UHF radio did not provide the communications capability to ensure the safety of the fire watch, which, in turn, was needed to ensure the safety of passengers and crewmembers. The Safety Board determined that had the *Universe Explorer* been equipped with an internal radio antenna network, which eliminates dead spots, radio communications would have been more effective during the emergency.

The fire occurred immediately below the hospital, forcing the ship's doctor and nurses to evacuate immediately. The *Universe Explorer* medical staff had only one radio, which meant that the nurses repeatedly had to go to the doctor to determine where their assistance was most needed. The lack of effective communications interfered with the medical staff's ability to render treatment to injured passengers and crewmembers. Had each member of the medical staff had a radio and a separate frequency on which to communicate so as not to interrupt other emergency transmissions, the doctor and nurses could have conferred over the radio without having to leave patients; as a result, many injury victims could have been treated sooner.

Fire conditions prevented the medical staff from accessing the medical supplies stored in the hospital. The bridge maintained an emergency medical kit, but it did not contain oxygen to treat the crewmembers who sustained smoke inhalation injuries. The Safety Board determined that the circumstances of this accident point out that cruise ships should have an auxiliary store of medical equipment and medicine for use in emergencies should the hospital become inaccessible.

Smoke from the main laundry fire on the *Universe Explorer* probably began spreading upward to the crew accommodations area before the bridge received the first fire alarm. Because of the delay in the bridge watch's closing the magnetic fire doors and because crewmembers compromised the effectiveness of some fire doors by tying them open, a massive, lethal amount of smoke quickly accumulated in the crew accommodations area, trapping a number of crewmen in their quarters. Their cabins lacked telephones or other means of communication with which they could signal their location or call for help. Crewmen tried to signal their need for assistance by waving a towel out of a porthole, by banging on walls, and by yelling for help; however, their efforts were ineffective. Because of the steel construction of the vessel, noises either migrated or were not audible, making it difficult for rescuers to accurately determine where trapped crewmembers were located. Rescuers did not locate several trapped crewmen until more than 2 ½ hours after the fire started. Had some stranded crewmen not found a room with a porthole, the number of fatalities would have been higher. However, had they had a means, such as an emergency call system similar to the flight attendant call system used on commercial airlines, by which they could signal their location, rescuers could have determined that location and helped them sooner, thereby reducing the number and severity of injuries to the trapped crewmen and exposing the search teams to fewer risks.

A number of factors adversely affected survivability on this ship. During the Safety Board's postaccident examination of the laundry, investigators observed that a bulkhead isolating the laundry area from the stair towers had been removed. The presence of the bulkhead would

not have prevented a fire from starting; however, it would have mitigated the propagation of smoke, thereby affording the crew a better chance for survival.

Records show that the vessel now known as the *Universe Explorer* was built in 1958 as a combination passenger/cargo ship, has been owned by a number of companies, and has undergone a number of major modifications. The present vessel operator indicated that the main laundry bulkhead was removed with the approval of the American Bureau of Shipping during a conversion completed in the early 1970s while the vessel was being operated by another company. However, classification and inspection authorities had no record of granting approval for removal of this bulkhead.

What particularly disturbs the Safety Board about the missing bulkhead is that it was still indicated on the fire control plan. Having an inaccurate fire control plan compromises the ability of officers to direct operations during a fire, which, in turn, places crewmembers and passengers at risk. This accident therefore demonstrates that passenger ship owners and operators need to be aware of the potential degradation to safety that can result not only from altering bulkheads, but also from failing to correct important vessel plans when such modifications are made.

When Safety Board investigators examined the main laundry after the fire, they noted that the smoke detectors were not connected to the fire detection system. The only active fire detection devices in the area were heat detectors. Records do not indicate why the smoke detectors were disconnected. However, from discussions with people experienced in laundry operations, fire experts, and detector manufacturers, the Safety Board determined that moisture, dust, and lint in the air of a laundry facility can trigger smoke detector sensors, resulting in false alarms, unless the devices are maintained appropriately. Heat-actuated detectors require more time than smoke detectors to actuate because a minimum level or minimum rate of heating must occur in the area of the device's sensor before the detector activates. The limitations of each type of detector could be reduced by establishing systems using both types of devices. Moreover, combining the system of detection with an automatic sprinkler system would provide a greater measure of safety by limiting the spread of fire. Based on its findings, the Safety Board concluded that greater fire protection can be attained in laundry facilities by using a combination of different types of detection devices, as well as an automatic suppression system.

The Safety Board is aware of other fire detection systems that are in development, including infrared and ultraviolet flame detectors and carbon monoxide detection systems. Some of these systems are currently available, and others are still being tested. Investigative research at the National Fire Academy has shown that using an alarm verification reset feature and cross zoning of fire detectors significantly reduce random false alarms and increase the reliability of fire detectors.

Given the high fire risk in laundry operations, improvements in the methods used to monitor such areas are essential. Conventional fire surveillance consists mainly of smoke and heat detectors. However, other methods are available that could augment passive sensory devices. Safety aboard a passenger vessel could also be improved by instituting improved surveillance measures, such as installing video cameras in high-fire-risk areas.

The *Universe Explorer* had electromagnetic fire doors on all stairway enclosures and main vertical zone boundaries, including the forward bulkhead of the main laundry. These fire doors did not close automatically; they had to be released either by someone pushing a local switch or by someone on bridge watch remotely closing them. Records indicate that on the morning of the accident, all fire doors were closed within less than 10 minutes of the first fire alarm. Nevertheless, during postaccident examination of the vessel, investigators found soot and debris patterns indicating that the fire doors, while open, had allowed the smoke and heat from the fire to enter the stairway, which then served as a flue, rapidly transmitting smoke and hot gases upward to other decks.

Had the fire doors leading from the main laundry to the stairways automatically closed when the fire started, the smoke and heat of the fire would probably have been contained within the boundaries of the main laundry long enough for crewmembers to have been warned of the fire and to have escaped from their berthing area. The Safety Board concluded that had automatic closure of the fire doors been incorporated in the fire detection system of the *Universe Explorer*, the doors near the fire would have shut immediately when nearby detectors activated, thereby restricting the spread of lethal amounts of smoke to the crew berthing areas.

Based on surveys of passengers and interviews with crewmembers, the Safety Board identified some deficiencies in on-board emergency procedures.

Some survey respondents stated that the passenger fire drill consisted of providing them with instructions on how to don a life preserver and on how to locate their muster stations. A large majority of those responding indicated that passengers were not told what to do should they see a fire or smell smoke. Passengers were particularly critical of the lack of information provided about the fire doors. About one-fourth of the responders characterized the drill as unrealistic because many passengers who knew the scheduled time of the drill went in advance to their lifeboats, using the elevators to reach their stations. One passenger complained that the drill did not prepare him to locate his life preserver because it had been placed on his bunk for the drill when he first arrived at his stateroom, whereas it was stowed in his room when he needed it during the actual emergency.

To have the maximum effectiveness, fire drills should be as realistic as possible. The content of the drill on the *Universe Explorer* left many passengers unprepared to meet the demands of the actual fire emergency. Allowing passengers to use elevators to reach their assembly stations during a drill does not prepare them to identify a safe route of escape. Further, not requiring passengers to observe approved safety procedures during drills may lead them to attempt the same shortcuts during the actual emergency, perhaps with tragic results. When dealing with a large group—in this case, 732 passengers—undoubtedly some individuals will become agitated or frightened during an actual emergency. When events occur for which passengers are not prepared, such as magnetic doors suddenly slamming shut, the likelihood increases that they will panic. Such reactions clearly support the need for passenger fire drills and for placards in staterooms that contain adequate instructions about fire emergencies. To be effective, a drill must provide passengers with the basic information, including:

- how to report a fire;
- what to expect if a fire occurs, such as typical announcements, actions of the crew, operation of the emergency lights, and operation of fire doors;
- the location and meaning of emergency signs;
- the description of emergency signals;
- if incapacitated, how to call for assistance; and
- the route to take from their stateroom to their assembly area.

The *Universe Explorer* conducted weekly crew emergency drills as required by the *Safety of Life at Sea* (SOLAS) Convention. The drills did not include, and were not required to include, identifying alternate escape routes from cabins and work sites. The berthing area where the fatalities occurred was forward of the crew galley and most work areas. Consequently, when crewmembers were alerted to the fire, they reacted according to habit in attempting to escape. They first tried to walk aft but could not continue because the increasing intensity of the heat and smoke forced them to turn around to find alternative escape routes. They said the heavy smoke stung their eyes and severely limited their visibility, requiring that they feel their way along the corridors until they found an exit. Although they had several other means of escape 50 to 60 feet away, locating an exit quickly was difficult. The position of the deceased crewmen's bodies in the passageways indicates that they probably were overcome by the heavy, toxic smoke while trying to find an escape route.

The 1995 amendments to the Standards for Training Certification and Watchkeeping Convention that became effective February 1, 1997, recognize the need for improved survival training. The amendments require that before being assigned to shipboard duties, crewmembers who are new to a seagoing ship must receive familiarization training in personal survival techniques or receive sufficient information and instructions to be able to perform certain tasks, including identifying emergency escape routes and muster and embarkation stations.

As the *Universe Explorer* fire demonstrates, knowledge of alternate escape routes is critical to the survival of crewmen during a fire emergency. While the Safety Board is pleased with the International Maritime Organization's initiative to improve survivability training for new seafarers, it is concerned that comparable instruction and refresher training is not available for all crewmembers. The Safety Board recognizes the impracticality of requiring today's passenger ships to drill their entire crews weekly on identifying and using alternate escape routes from work and berthing areas. Nevertheless, crewmembers need more than a one-time training session in survivability, especially if, as new employees, they receive such instruction when they also have to familiarize themselves with numerous other vessel operations.

As mentioned earlier, several trapped crewmen were not located by rescuers until more than 2 ½ hours after the fire started. According to interviews, the ship's two fire teams assembled, donned protective gear; and marshaled firefighting equipment within minutes of the crew alert to report to emergency stations. Despite the prompt initial action, the trapped crewmen

were not located in a timely manner because the search was not conducted in an organized, systematic manner. Rather, the staff captain directed one fire team member to don breathing equipment and search the crew area. The lone searcher said that he encountered intense and blinding smoke, saw the fallen crewmembers, and heard people calling for help but saw nothing but smoke. He returned to the staging area, whereupon the staff captain directed a second team member to join the first searcher and return to remove the fallen crewmen. However, they did not immediately initiate follow-up actions to find the trapped crewmen.

Again, having a lone individual—in this case the fire team member—search an area of a vessel during a fire was ill-advised and dangerous. The searcher could have needed help himself or could have encountered people who needed assistance that was beyond the ability of one person to provide. The delay and lack of systematic effort in rescuing trapped crewmembers demonstrates that the *Universe Explorer* crew was not adequately prepared to conduct rescue operations. The Safety Board concluded that if the *Universe Explorer* had had a properly equipped rescue team that was trained in locating and recovering people trapped in smoke-filled areas, the crewmen probably would have been rescued sooner and would have sustained less severe injuries; moreover, fewer crewmen may have died.

Before this fire, the *Universe Explorer* had sailed for almost 40 years without a major incident. The combined effect of a few physical conditions, several systemic problems, and less than adequate company policies and procedures compromised the safety of the vessel, ultimately resulting in a fire and the deaths of several crewmen. Safety-conscious passenger vessel owners and operators need to be made aware of the circumstances of this accident so that they may examine their fleets and policies for the purpose of potentially improving the fire safety environment of their vessels.

Therefore, the National Transportation Safety Board recommends that the International Council of Cruise Lines:

> Advise member companies of the circumstances of this accident and recommend that they institute procedures and, if necessary, upgrade equipment to establish reliable internal radio communications from anywhere inside a vessel during an emergency. (M-98-58)
>
> Recommend that member passenger ship companies install emergency call systems in passenger staterooms and crew cabins so that people trapped during a fire emergency will have a means of signaling their location. (M-98-59)
>
> Inform member companies of the importance of providing each member of the shipboard medical staff with a reliable radio and communications training for emergencies. (M-98-60)
>
> Remind member companies of the possible need to institute improved surveillance measures for high-fire-risk areas on their ships. (M-98-61)

Recommend that member companies integrate heat and/or smoke detectors with automatic fire door release switches so that the doors in the immediate area of a fire will close automatically when the detectors are activated. (M-98-62)

Recommend that member companies review and, if necessary, revise passenger fire drills and stateroom placards to advise passengers what to expect in the event of a fire emergency. (M-98-63)

Recommend that member companies provide periodic instruction or drills on alternative escape routes to all crewmembers on passenger ships to reinforce the familiarization training required of new seafarers by the 1995 Amendments to the Standards for Training Certification and Watchkeeping Convention. (M-98-64)

Encourage member companies to establish specially trained and equipped shipboard rescue teams to conduct rescue operations from smoke-filled areas. (M-98-65)

In consultation with member passenger ship operators, determine the amount and type of medical equipment and medicines needed during an emergency and recommend that such supplies be maintained in suitable locations outside of the ship's hospital in case the hospital becomes inaccessible. (M-98-66)

Remind member companies of the degradation to structural fire protection that can result from altering fire control boundaries and of their responsibility to maintain the accuracy of vessel fire control plans. (M-98-67)

Also, the Safety Board issued Safety Recommendations M-98-31 through -41 to the U.S. Coast Guard, M-98-42 through -57 to New Commodore Cruise Line, Ltd., and to V. Ships Marine, Ltd., and M-98-68 to the American Bureau of Shipping.

The National Transportation Safety Board is an independent Federal agency with the statutory responsibility "to promote transportation safety by conducting independent accident investigations and by formulating safety improvement recommendations" (Public Law 93-633). The Safety Board is interested in any action taken as a result of its safety recommendations. Therefore, it would appreciate a response from you regarding action taken or contemplated with respect to the recommendations in this letter. Please refer to Safety Recommendations M-98-58 through -67 in your reply. If you have any questions, you may call (202) 314-6455.

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in these recommendations.

By: Jim Hall
Chairman

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: May 21, 1998
In reply refer to: M-98-68

Mr. Frank J. Iarossi
Chairman and President
American Bureau of Shipping
Two World Trade Center
106th Floor
New York, New York 10048

Early on July 27, 1996, while the Panamanian passenger ship *Universe Explorer* was en route from Juneau, Alaska, to Glacier Bay, Alaska, with 1,006 people aboard, a fire started in the main laundry. Dense smoke and heat spread upward to a deck on which crew accommodation quarters were located. Five crewmembers died from smoke inhalation and 55 crewmembers and 1 passenger sustained minor or serious injuries. One passenger required medical treatment as a result of a pre-existing condition. Sixty-nine people were transported to area hospitals, where 13 of the injured were admitted for further treatment. [1] The estimated damage to the ship was $1.5 million.

During its postaccident examination of the main laundry, the National Transportation Safety Board observed that a bulkhead indicated on the vessel fire control plan was missing. Given the unknown origin of the blaze, the presence of the bulkhead may not have prevented a fire from starting; however, had the bulkhead been in place, it would have mitigated the propagation of smoke and heat, thereby affording the crew a better chance for survival. The Safety Board therefore concluded that the removal of the corridor bulkhead in the main laundry was an alteration to the vessel that seriously degraded the fire safety condition of the *Universe Explorer*.

The ABS exercised the primary inspection responsibility over the *Universe Explorer*. Not only did it conduct annual and special surveys for the purpose of confirming that the vessel met classification rules for insurance purposes, it also acted in a regulatory capacity on behalf of the flag administration (Panama) to ensure that the ship complied with the *Safety of Life at Sea* (SOLAS) Convention requirements.

Before the fire occurred, the ABS reviewed and approved a number of operational plans for the *Universe Explorer*. A Damage Control Plan approved by the ABS in 1985 and a

[1] For additional information, refer to Marine Accident Report—*Fire On Board the Panamanian Passenger Ship* Universe Explorer *in the Lynn Canal Near Juneau, Alaska, July 27, 1996 (NTSB/MAR-98/02)*.

Lifesaving Plan approved by the ABS in 1990 each show the main laundry without the corridor bulkhead. In 1991, the ABS approved the fire control plan for the *Universe Explorer* that showed the corridor bulkhead in the main laundry. The Safety Board is concerned that the ABS approved a vessel plan, especially a plan as critical as the fire control plan, that did not accurately depict the ship's configuration. If the classification society's survey procedures were effective, its surveyors should have found this discrepancy and, at a minimum, required the fire control plan be corrected in 1991. In correspondence with the Safety Board after the fire, the ABS stated that it had no documents on file regarding the bulkhead and did not know when it had been removed.

In 1958, when the vessel was built, the original owner and the U.S. Coast Guard considered the main laundry corridor bulkhead not only practicable but necessary to achieve an adequate measure of fire safety on the vessel. The 46 *Code of Federal Regulations* stipulates that type 2 stairways[2] should not give direct access to enclosed spaces in which a fire may originate.

The ABS classed the newly constructed vessel. With the exception of the 8-year period during which the ship was classed by Lloyd's Registry of Shipping, the ABS surveyed and classed the vessel throughout its service life, reviewing and approving various fire control plans, all of which indicate that the main laundry had a corridor bulkhead. After the fire, when advised that the bulkhead had been removed, an ABS official stated that the laundry bulkhead did not have to be in place for the vessel to comply with ABS classification requirements or the statutory requirements of the flag administration, Panama, at the time of the casualty. He cited SOLAS 48 as the basis for his contention.

The Safety Board is disturbed by the ABS's postaccident interpretation of the international requirements. Removing the bulkhead reduced the level of fire safety, which is not permitted by SOLAS. For the ABS to interpret that the laundry bulkhead once required by SOLAS 48 can be removed indicates that the classification agency has effectively accepted the degradation of fire safety on this passenger vessel.

A review of ABS procedures indicates that its surveyors check an ABS-classed vessel's approved plans against its internal arrangements only when a new owner applies for certifying approval or after a structural modification authorized by the ABS has been made to the vessel; they do not review structural plans as part of routine surveys.

Therefore, the National Transportation Safety Board recommends that the American Bureau of Shipping:

> Analyze your plan review procedures and institute improved safeguards to ensure that ship plans submitted for approval accurately depict the configuration of the vessel. (M-98-68)

[2] Type 1 stairways are enclosed stair towers bordering main vertical zones. Type 2 stairways are enclosed stairways other than type 1.

Also, the Safety Board issued Safety Recommendations M-98-31 through -41 to the U.S. Coast Guard, M-98-42 through -57 to New Commodore Cruise Line, Inc., and to V. Ships Marine, Ltd., and M-98-58 through -67 to the International Council of Cruise Lines.

The National Transportation Safety Board is an independent Federal agency with the statutory responsibility "to promote transportation safety by conducting independent accident investigations and by formulating safety improvement recommendations" (Public Law 93-633). The Safety Board is interested in any action taken as a result of its safety recommendations. Therefore, it would appreciate a response from you regarding action taken or contemplated with respect to the recommendation in this letter. Please refer to Safety Recommendation M-98-68 in your reply. If you have any questions, you may call (202) 314-6455.

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in this recommendation.

By: Jim Hall
Chairman

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: May 19, 1998

In reply refer to: M-98-69 through -81

Admiral Robert E. Kramek
Commandant
U.S. Coast Guard
Washington, D.C. 20593-0001

The 560-foot-long Liberian tankship *Julie N,* carrying a cargo of heating oil, collided with the south bascule pier of the Portland-South Portland (Million Dollar) Bridge in Portland, Maine, about 1105 on September 27, 1996. The vessel had passed between the piers of the new Portland-South Portland bridge (Casco Bay Bridge) and was en route to the Rolling Mills terminal about 1.2 miles beyond the Million Dollar Bridge. The vessel was under the direction of a State-licensed docking master (pilot). After the collision, the pilot stated that as the vessel approached the bridge, he had issued three orders for port rudder to swing the bow to the left and then intended to order the rudder to hard starboard and to increase the engine speed from slow to half ahead to stop the swing and align the vessel for passage through the drawspan. However, the pilot inadvertently ordered the rudder to hard port instead of hard starboard. He recognized his error within seconds and ordered the rudder to hard starboard; given the narrowness of the bridge span, however, the shifting of the rudder occurred too late to avoid the collision.[1]

There were no injuries, but the collision resulted in a 30-foot-long hole in the vessel's hull beneath the waterline. About 4,000 barrels of oil spilled into the harbor. The vessel sustained about $660,000 in damage, and the cost for cleanup of the oil was approximately $43 million. Repairs to the Million Dollar Bridge were about $232,000.

The National Transportation Safety Board determines that the probable cause of the collision with the Portland-South Portland (Million Dollar) Bridge was the pilot's inadvertent order to port (left) rudder instead of starboard (right) rudder. Contributing to the accident was the narrow horizontal clearance of the bridge drawspan, which afforded little leeway for human error. Contributing to the severity of the damage to the vessel and to the amount of oil spilled was a corner of the bridge pier that was not adequately shielded by the timber fender system.

[1]For additional information, refer to Marine Special Investigation Report—*Postaccident Testing for Alcohol and Drugs in the Marine Industry and the Ramming of the Portland-South Portland (Million Dollar Bridge) at Portland, Maine, by the Liberian Tankship* Julie N *on September 27, 1996* (NTSB/SIR-98/02).

Improving the chances of successfully navigating the bridge would require altering the procedures, vessels, or environment so that the job is made easier. For example, the establishment of permanent ranges would provide an easily observable means for checking alignment for passage through the drawspan and would make it easier to detect errors in alignment and correct them. The Safety Board concludes that establishing a range of navigation marks and lights would contribute to safe navigation in the area where the accident occurred. To further aid navigation, new operational guidelines may be needed to meet changes in the character of navigation. In Portland, any future operational guidance for vessels would likely involve guidance developed by the Captain of the Port or the Port Safety Forum on how and when to transit the new bridge. In order to be recognized and used by vessel masters and pilots, the Safety Board concludes that such operational guidance should be published in a readily available publication such as the *U.S. Coast Pilot*.

In addition to the port safety issues related to the probable cause of the *Julie N* accident, continuing problems encountered in conducting postaccident testing for alcohol and drugs[2] prompted the Safety Board to focus on the following postaccident testing issues:

- Timeliness of and accountability for testing,
- Testing and enforcement responsibilities, and
- Consistency of U.S. Coast Guard regulations with one another and with regulations in other transportation modes.

Timeliness of testing has been a recurring problem in major marine accidents investigated by the Safety Board. In the *Julie N* accident, the technicians elected to collect urine specimens first and conduct breath testing later. Thus, breath testing did not commence until about 1620, more than 5 hours after the accident, and was not completed until nearly 1800. Moreover, the master, the crewmember most directly involved in the accident, was among the last to be tested. This demonstrates that despite preparations by the vessel operator and timely orders to the testing contractor to conduct the testing, it is possible to conduct less than adequate testing and not be in violation of the regulations. Consequently, the Safety Board concludes that Coast Guard regulations for postaccident testing do not communicate clearly that alcohol testing is more time-sensitive and should be conducted as early as possible and, when possible, before collecting urine specimens.

In addition, alcohol or drugs could not be ruled out in numerous accidents investigated by the Safety Board because the postaccident testing was either not done or was delayed so long as to make the testing meaningless. For instance, in the *Julie N* accident, the pilot failed to be tested for alcohol because of the Coast Guard's failure to adequately address the industry-wide problem of postaccident alcohol and drug testing. Postaccident testing is not yet a reliable process for examining the factors of probable cause or for accurately assessing influences on safety

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[2]The five drugs listed in the Department of Transportation regulations at 49 CFR 40.21 and the Coast Guard regulations at 46 CFR 16.350 are marijuana, cocaine, opiates, phencyclidines (PCPs), and amphetamines.

attributable to alcohol or drugs, as is illustrated by the *Julie N* and five subsequent accidents shown in table 1 (enclosure 1).

The regulations at 33 *Code of Federal Regulations* (CFR) 95 and 46 CFR 4.06 both place the responsibility for testing on the marine employer; however, until late 1996, neither set of regulations contained enforcement provisions that could be applied to the marine employer. Lacking enforcement, the Coast Guard had to rely upon education and persuasion to get marine employers to recognize and carry out their responsibilities under the regulations for postaccident testing. The recently acquired authority in 46 *United States Codes* (U.S.C.) 2115 to impose civil penalties on marine employers, as well as others, for failing to comply with the postaccident testing regulations is a valuable new tool for the Coast Guard. The fact that the Coast Guard now has this authority should be conveyed to all Coast Guard personnel involved in enforcing the postaccident testing regulations.

Because the Coast Guard now has the needed authority to enforce its postaccident testing regulations, it should make enforcing these regulations a high priority and should develop a Service-wide program with procedures and guidance to ensure that postaccident testing is an effective, reliable process for accident investigation and enforcement.

Even a well-informed vessel operator may have other responsibilities following an accident that require a higher priority than postaccident testing and thus result in delayed testing for alcohol. Accordingly, it appears that the present procedure for testing will continue to result in unacceptable delays in alcohol testing, unless the Coast Guard becomes more actively involved in ensuring that marine employers make reasonable efforts to conduct timely testing. One way in which the Coast Guard could facilitate timely testing would be by having Coast Guard personnel conduct testing under certain circumstances. In the *Julie N* accident, a Coast Guard representative was able to board the vessel about 1230; hence, it would have been possible to initiate breath testing of the few individuals directly involved in the accident at that time, less than 2 hours after the accident.

The Coast Guard routinely performs breath testing for alcohol of operators of recreational vessels when such operators are involved in incidents or appear to be operating improperly. It would appear feasible for the Coast Guard personnel currently performing breath testing of recreational vessel operators to conduct breath testing for alcohol of the individuals on commercial vessels that are directly involved in serious marine incidents. Coast Guard personnel who are assigned to perform law enforcement or port safety functions normally would be able to be on scene to conduct breath testing for alcohol much sooner than the owner/operator or the owner/operator's testing contractor. Requiring trained Coast Guard personnel to perform testing of individuals on commercial vessels that are involved in serious marine incidents would not appear to represent a significant increase in workload, and such a procedure would most likely result in timely testing for alcohol. In fact, breath testing for alcohol may currently be conducted by appropriately trained Coast Guard personnel if such testing would be more timely than that arranged by the marine employer (ALDIST 179/94).

The Safety Board concludes that although the primary responsibility for postaccident testing for alcohol and dangerous drugs should remain with the marine employer, the timeliness

of postaccident alcohol testing on commercial vessels could be greatly improved by having Coast Guard personnel conduct breath testing of crewmembers involved in an accident.

The availability of crewmembers for testing can also adversely affect testing timeliness. Although not an issue in the *Julie N* accident, in other accidents, marine pilots and crewmembers have not been available for testing. Unless the crew is placed under subpoena, nothing prevents the crew of a foreign vessel from being transported out of the country. Accordingly, it should be required, when feasible, that the entire crew, including the marine pilot, remain with the vessel for breath testing by the Coast Guard, or until given permission by the Coast Guard to leave the vessel. The Safety Board concludes that requiring the crewmembers and pilot involved in a marine accident to remain with the vessel, when it is safe to do so, for breath testing by the Coast Guard would help to ensure that these individuals are tested for alcohol in a timely manner.

The availability of testing equipment can also affect the timeliness of postaccident testing. The regulations at 46 CFR 4.06 require U.S. oceangoing ships to carry breath-testing devices and to have urine specimen collection and shipping kits readily available.[3] The Safety Board considers the intent of this requirement to be a reasonable effort to enable postaccident testing to be carried out expeditiously. Unfortunately, the option allowing vessels to forgo carrying the urine collection and shipping kits if they can be obtained in 24 hours can defeat the intent of the regulation and lead to unacceptable delays in testing. Eliminating the 24-hour option and requiring the equipment to be on board would eliminate the need to acquire this equipment on a time-consuming case-by-case basis and then transport the equipment to the vessel. Having the equipment on board would also make it possible for the vessel's officers to conduct testing when Coast Guard or shore-side technicians cannot reach the vessel in a timely manner.

Because most oceangoing ships entering U.S. ports are foreign vessels,[4] it appears likely that marine casualties will probably involve such vessels as frequently as U.S. flag vessels. This is borne out by the data in table 1, which show that over half of the accidents on U.S navigable waters investigated by the Safety Board involved foreign vessels. Accordingly, the Safety Board concludes that foreign, as well as U.S. vessels, should be required to carry breath-testing devices and urine specimen collection and shipping kits on board so that postaccident testing can be carried out in a timely manner. In addition, the Safety Board believes that having the breath-testing and urine collection/shipping kits on board is important for timely testing, but knowledge about how to use the devices is also crucial. Therefore, the Safety Board further concludes that a vessel plan for conducting postaccident testing would ensure that the marine employer and vessel personnel would be aware of the requirements for postaccident testing, trained to use the testing and collection equipment on board, and informed about where to send urine specimens for analysis.

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[3]The *Julie N* had such equipment on board, but Maritime Overseas Corporation (MOC), the operator of the vessel, elected to have an independent contractor perform the testing. MOC only allows crewmembers to perform postaccident testing when an independent testing agency is not readily available.

[4]According to data collected by the U.S. Customs Service and collated by the Bureau of the Census, there were 85,330 port calls (arrival of vessels) to U.S. ports in 1996 by foreign vessels and 10,170 by U.S vessels. Some port calls were made by the same vessel, as it is common for a vessel to visit more than one U.S. port during a voyage to the United States.

Many postaccident testing reliability and reliability problems can be traced to the lack of uniformity between 33 CFR 95 and 46 CFR 4.06, as illustrated by table 2 (enclosure 2). This lack of uniformity regarding when to test and what specimens to collect for what purpose probably contributed to the misunderstanding expressed by the pilot of the *Julie N* and the principal owner of the tugboat company that only urine was needed for postaccident testing. The situation could be improved readily by inserting a minimal amount of text to explain that:

- Breath or blood is required for alcohol testing, and
- Urine is required solely for determining the use of dangerous drugs.

A simple, clear explanation of the purposes of the two categories of specimens would help eliminate confusion and misconceptions about postaccident testing and would assist the Coast Guard in its continuing effort to inform the public about testing requirements. Accordingly, the Safety Board concludes that including text in the regulations to clarify that breath or blood specimens are for alcohol testing and that urine specimens are for determining the presence of dangerous drugs would help to inform the marine industry that both urine and breath or blood specimens are required for postaccident testing.

The two sets of rules also have different thresholds for initiating postaccident testing. In 33 CFR 95, testing is required when an individual is involved in a marine accident as defined somewhat generally at 46 U.S.C. 61, whereas in 46 CFR 4.06, the threshold is a "serious marine incident," as defined very specifically at 46 CFR 4.03-2. The definition of serious marine incident, which includes discharges of oil of 10,000 gallons or more, appears to be well crafted to provide a reasonable threshold for accidents involving commercial vessels that are serious enough to warrant testing and to exclude lesser accidents where the consequences would not be severe. The Safety Board concludes that adopting the "serious marine incident" criteria described in 46 CFR 4.03-2 as the criteria for initiating postaccident testing involving commercial vessels would provide uniform, easily understood conditions for initiating testing.

In addition, the regulations at 33 CFR 95 and 46 CFR 4.06 do not specify a time limit for postaccident testing or set a priority for alcohol testing. As was mentioned earlier, the *Julie N*'s crew did not commence alcohol testing until more than 5 hours after the accident because the testing technicians elected to collect urine specimens first. These actions complied with the current regulations (33 CFR 95 and 46 CFR 4.06), which call for testing "as soon as practicable," rather than requiring specific sampling times.

Because of its concerns about the time sensitivity of toxicological sampling, in 1989, the Safety Board recommended[5] to the Department of Transportation (DOT) that both blood and urine samples be collected within 4 hours of a transportation accident. Subsequent Congressional concern about the possible use of alcohol by transportation workers resulted in the passage of the Omnibus Transportation Employee Testing Act of 1991 (the Act). The preamble to the testing

[5]Safety Recommendation I-89-006 was issued in a December 5, 1989, letter to the DOT and classified "Closed—Unacceptable Action," on May 15, 1995.

regulations adopted by other DOT administrations[6] pursuant to the Act sets a 2-hour time period for alcohol testing and a requirement to document any failure to test.

Because alcohol is eliminated very quickly from the body and because the rate of elimination can vary among people, testing very soon after an accident affords the best opportunity to ascertain whether alcohol could be a casual factor in the accident. An additional requirement for a written record of failure to test will emphasize to the marine employers that timely testing for alcohol is needed and is expected to raise the priority for testing in relation to other postaccident responsibilities and concerns. The information in the written record will also enable the Coast Guard to ascertain how closely the various marine employers are complying, determine whether adjustments in the program are needed, and decide whether enforcement action is called for. Accordingly, the Safety Board concludes that adopting testing timeliness and documentation requirements would result in more timely testing and facilitate effective oversight by the Coast Guard.

The Safety Board believes that confusion regarding postaccident testing requirements and procedures will persist as long as two sets of regulations exist on postaccident testing that contain different information. To address this problem, two options appear feasible: (1) Rewrite and consolidate both sets of regulations to make them identical or (2) Locate the consolidated regulations solely in either Title 33 (33 CFR 95) or Title 46 (46 CFR 4.06).

Title 33, *Navigation and Navigable Waters* covers numerous operational topics,[7] the majority of which pertain to all vessels transiting U.S. waters or visiting U.S. ports. Because the majority of the Title 33 regulations pertain to foreign vessels operating on U.S. waters, as well as U.S. vessels, Title 33 is a logical location for the regulations concerning *Operating a Vessel While Intoxicated* (33 CFR 95). The Safety Board concludes that the guidance to conduct testing following marine accidents, being operational in nature and applicable to all vessels, would fit best in Title 33 of the regulations.

Conversely, the Title 46 regulations are almost exclusively concerned with U.S. commercial vessels and U.S. mariners and are directed at marine employers. The first part of Title 46, Subchapter A, *Procedures Applicable To The Public,* and Part 4 of Subchapter A, *Marine Casualties Investigations,* are widely recognized as applicable to foreign vessels that experience a marine accident on U.S. waters as well as to U.S. vessels anywhere. Accordingly, the location of regulations for *Mandatory Chemical Testing Following Serious Marine Incidents Involving Vessels in Commercial Service* at 46 CFR 4.06 is logical. However, Title 46, because it is largely devoted to U.S. mariners and vessels, does not invite or attract the attention of foreign vessel operators until they become involved in a marine accident.

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[6]Federal Aviation Administration, Federal Railroad Administration, Federal Highway Administration, Federal Transit Administration, and Research and Special Programs Administration.

[7]Of the 16 subchapters in Title 33 relating to Coast Guard functions, 12 are of interest to all vessels, including foreign vessels.

The Safety Board concludes that the guidance to conduct testing following marine accidents, being operational in nature and applicable to all vessels, would fit best in Title 33 of the regulations. Because one of the purposes of postaccident testing is to determine intoxication from alcohol, the standards for intoxication should be a part of the testing regulations to avoid the need to refer to other parts of the regulations which can be time-consuming and result in confusion. The Safety Board concludes that renaming and expanding 33 CFR 95, *Operating a Vessel While Impaired (Intoxicated)*, by incorporating the present regulations at 46 CFR 4.06, *Mandatory Chemical Testing Following Serious Marine Incidents Involving Vessels in Commercial Service*, into 33 CFR 95 would eliminate the confusion caused by two sets of regulations, contribute to better understanding of the intent of the regulations, achieve improved testing for alcohol and drugs, and demonstrate that postaccident testing applies to all vessels experiencing a serious marine incident on U.S. waters.

The preamble to the testing regulations adopted in other DOT administrations pursuant to the Omnibus Transportation Employee Testing Act of 1991 established an additional requirement concerning postaccident drinking that appears appropriate to commercial marine vessels. This requirement prohibits anyone involved in an accident from consuming alcohol for 8 hours following the accident.

The ability to discern an individual's blood alcohol concentration (BAC) can also be affected by postaccident drinking. While the need for individuals involved in a serious accident to refrain from consuming alcohol may be obvious, there is little reason to believe that individuals involved will automatically avoid alcohol. Further, someone who regularly consumes alcohol may be disposed to do so following the stress that can be associated with an accident. A clear regulation applicable to commercial vessels, including foreign vessels on U.S. waters, would probably be sufficient to obtain compliance in most cases. Also, it would enable the Coast Guard to take enforcement action when warranted. Accordingly, the Safety Board concludes that adopting a requirement prohibiting individuals involved in a marine accident from consuming alcohol within 8 hours of the accident would help to ensure that such individuals can be tested to determine their BAC.

Therefore, the National Transportation Safety Board recommends that the U.S. Coast Guard:

> Evaluate the benefit of a permanent set of ranges for vessel pilots and masters to use for navigating through the Casco Bay Bridge and establish such ranges if justified. (M-98-69)
>
> Ensure that operational guidance for vessels navigating Portland harbor developed by the Port Safety Forum or by the Captain of the Port is published in a source readily available to vessel masters and pilots, such as the *U.S. Coast Pilot*. (M-98-70)

Incorporate language into the postaccident testing regulations that clearly states alcohol testing is more time-sensitive and therefore should be conducted ahead of drug testing. (M-98-71)

Institute a task force that will evaluate deficiencies in past postaccident alcohol and drug testing performance and use "lessons learned" to implement a program that ensures testing is performed in a manner that will produce meaningful results. (M-98-72)

Implement a procedure for Coast Guard personnel to conduct breath testing of mariners who are involved in a serious marine incident, as defined by 46 CFR 4.03-2, when testing by the marine employer will not or can not take place within 2 hours of the accident. (M-98-73)

Establish a requirement in the postaccident testing regulations that the crew and pilot of a vessel involved in a serious marine incident will remain with the vessel, when it is safe to do so, for breath testing for alcohol, until permitted by the Coast Guard to leave the vessel. (M-98-74)

Establish a requirement in the postaccident testing regulations that foreign commercial vessels on the navigable waters of the United States, as well as U.S. oceangoing vessels, must have on board breath-testing devices capable of determining the presence of alcohol in a person's system and urine specimen collection and shipping kits. (M-98-75)

Establish a requirement in the postaccident testing regulations that foreign vessels on the navigable waters of the United States and oceangoing U.S. vessels have a postaccident testing plan that identifies crewmembers who will conduct the testing; sets forth the qualifications for crewmembers assigned to conduct the testing; establishes procedures for the care of specimens, including chain of custody; lists the records to be prepared; and provides identification and addresses for testing laboratories that can process urine specimens or testing firms that may assist or conduct postaccident testing for vessels in U.S. ports. (M-98-76)

Incorporate language into the postaccident testing regulations that clearly states that breath or blood specimens are for determining the presence of alcohol and that urine specimens are used to determine the presence of dangerous drugs. (M-98-77)

To provide uniformity, adopt the criteria for "serious marine incident" described at 46 CFR 4.03-2 as the criteria for initiating postaccident testing for

commercial vessels in the regulations at 33 CFR 95 and in any future combined regulations. (M-98-78)

Establish a requirement that postaccident testing for drugs begin within 4 hours of a serious marine incident and postaccident testing for alcohol begin within 2 hours of a serious marine incident, with attempts to test for alcohol ceasing after 8 hours, and establish a requirement that the marine employer document any testing delays or failures. (M-98-79)

Expand the regulations at 33 CFR 95 to incorporate the provisions for postaccident testing currently found at 46 CFR 4.06 with a minimum of cross-referencing to other regulations, so that postaccident testing requirements are easy to read and comprehend and are found in one part of the regulations. (M-98-80)

Establish a provision in the postaccident testing regulations that prohibits mariners involved in an accident from consuming alcohol for 8 hours afterwards, or until breath or blood and urine specimens are collected, or until released by the Coast Guard. (M-98-81)

Also, the Safety Board issued Safety Recommendation M-98-82 to the Maine Department of Transportation, M-98-83 to the Federal Highway Administration, and M-98-84 to the American Association of State Highway and Transportation Officials.

Please refer to Safety Recommendations M-98-69 through -81 in your reply. If you need additional information, you may call (202) 314-6457.

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in these recommendations.

By: Jim Hall
Chairman

Enclosures (2)

Table 1—Time elapsed before postaccident testing performed and types of testing performed after major marine accidents investigated by the Safety Board

Vessel	Breath/blood testing (hours)	Urine testing (hours)	Remarks
Exxon Valdez March 24, 1989	—/10.5	10.5	▪ Testing delayed because of time necessary for Coast Guard investigators arrive at scene and the several hours it took to locate a collector. ▪ Alcohol was a causal factor.
World Prodigy June 23, 1989	—/22	22	None.
Aleutian Enterprise March 22, 1990	—/—	42	▪ Remote location. Lack of knowledge by marine employer about postaccident testing. Urine specimen from master tested negative.
Shinousa/ *Chandy N* *Hellespont Faith* July 28, 1990	—/—	8	▪ USCG investigators on board soon after accident to interview crews observed no evidence of intoxication or drug use. Pilot of *Shinousa* gave urine specimen in about 8 hours. All other urine collected over 24 hours later.
Mandan August 15, 1990	5.5/—	5.5	▪ Pilot and master tested. ▪ Test results were negative for alcohol and drugs.
Jupiter Buffalo September 16, 1990	—/—	Unknown/9.5	▪ USCG investigators reminded *Buffalo* of need for alcohol and drug testing about 6 hours after accident. Some crewmembers had gone ashore already; thus, no alcohol testing attempted of *Buffalo* crew. No one thought to test *Jupiter* injured that were hospitalized. Deceased *Jupiter* crewman tested negative for drugs.
Sea King January 11, 1991	—/—	—	▪ Owner refused to test. Lack of authority at time to impose penalty against the owner for failure to test. Master rescued by USCG soon after accident. ▪ Unknown whether alcohol or drugs involved.
QE 2 August 7, 1992	—/39	16-39	▪ Remote location. Marine employer's instructions were to cooperate with USCG in postaccident testing. ▪ Test results were negative for drugs.
Fremont/ *Juraj Dalmatinac* December 21, 1992	—/— —/—	18 14-16	None.
Chris May 28, 1993	—/7–7.5	7–7.5	▪ USCG on scene a few minutes after the accident.
Yorktown Clipper August 18, 1993	—/—	18.5	▪ Remote location.
Mauvilla September 22, 1993	—/—	8	▪ Remote location.
Omi Charger October 9, 1993	—/—	5–18	▪ Postaccident drinking. Lack of knowledge by marine employer. Testing initiated by USCG by informing marine employer of need for testing and how to obtain testing assistance.
Noordam/ *Mount Ymitos* November 6, 1993	7/— Yes/—	7–26 29–30	▪ No authority to conduct testing of foreign vessels in international waters. However, watchstanders volunteered for testing.

Vessel	Breath/blood testing (hours)	Urine testing (hours)	Remarks
El Toro December 5, 1993	—/3–6	—	▪ Test results were negative for alcohol and drugs.
All Alaskan July 24, 1994	—/—	28	▪ Master not tested. Master boarded USCG cutter about 3 hours after fire started but was not tested during the 3 days on board. Health clinic closed; thus, urine collection of crew delayed until next day.
Seal Island October 8, 1994	—/—	—	▪ In port at St. Croix, Virgin Islands. Lack of knowledge by marine employer of testing requirements.
Alaska Spirit May 27, 1995	—/Postmortem	Not applicable	None.
Royal Majesty June 10, 1995	—/25–28	25–28	▪ No authority to conduct testing of foreign vessel in international waters. Remote location. Crew volunteered to be tested.
Star Princess June 23, 1995	Pilot 4/— Crew 8.5/—	4 8.5	▪ Test results were negative for alcohol and drugs (pilot).
Scandia January 19, 1996	9/—	15.7	▪ Remote location. Crew fighting fire and attempting to salvage barge. USCG performed breath testing of crew for alcohol. ▪ Test results were negative for alcohol and drugs.
Universe Explorer July 27, 1996	—/—	34	None.
Julie N September 27, 1996	Pilot —/— Crew 3–7/—	3 3–7	▪ Lack of knowledge by marine employer. ▪ Test results of pilot were negative for drugs. ▪ Breath testing of *Julie N* crew delayed by technicians who elected to collect urine specimens first. ▪ Test results were negative for alcohol and drugs.
Dave Blackburn October 23, 1996	9/—	9	None.
Sundowner December 7, 1996	—/16–17	16–17	▪ No breath testing conducted because owner reported to USCG that he had permitted crew to engage in postaccident drinking. Testing consortium under contract not open after hours and on weekends, thus delaying specimen collection. ▪ Unknown whether alcohol or drugs involved.
Bright Field December 7, 1996	Crew 6.5–8.5/— Pilot 1.5/—	6.5–8.5 1.5	▪ USCG on board soon after accident; reminded owner of need for testing. Directly involved personnel were tested last. ▪ Test results were negative for alcohol and drugs.
Cowslip/ *Evergrade* May 14, 1997	*Cowslip* —/8.6–10 Pilot —/— *Evergrade* —/17.5–18.5	8.6–10 12.7 17.5–18.5	▪ *Cowslip* is a USCG cutter.
Alaska 1/ *Hanjin Barcelona* February 11, 1998	6/— —/—	6 —	▪ Saliva collected instead breath for alcohol testing. ▪ No authority to test crew of *Hanjin Barcelona* because ship was a foreign vessel in international waters. ▪ Unknown whether alcohol or drugs involved.

Table 2—Coast Guard regulations governing postaccident testing

	33 CFR 95	46 CFR 4.06
Applicability	▪ Commercial vessels–U.S. and foreign flag ▪ Recreational vessels–U.S. and foreign flag	▪ U. S. commercial vessels ▪ Foreign-flag commercial vessels on U.S. waters
Intoxication standards for alcohol	▪ Commercial operators–.04 percent blood alcohol concentration (BAC) ▪ Recreational vessels–.10 percent BAC or State Standard	None
Testing samples	General— ▪ Breath ▪ Blood ▪ Urine ▪ Saliva or other bodily fluids or tissues	▪ Urine ▪ Breath or blood or both
Criteria for testing	Accident meeting criteria of 46 U.S.C. 6101: ▪ Death or serious injury to individual ▪ Material loss of property ▪ Material damage affecting seaworthiness or efficiency of vessel ▪ Significant harm to the environment -OR- Individual suspected of being intoxicated	Accident meeting "serious marine incident" criteria of 46 CFR 4.03-2: ▪ One or more deaths ▪ Injury to passenger or crewmember requiring medical treatment beyond first aid or injury rendering crewmember unfit for routine vessel duties ▪ Property damage exceeding $100,000 ▪ Loss of inspected vessel ▪ Loss of self-propelled vessel of 100 gross tons ▪ Discharge of 10,000 gallons of oil into navigable waters of U.S. or reportable quantity of hazardous substance into navigable waters or atmosphere of U.S.
Penalties for refusal to test*	Suspension or revocation of employee's license; none against marine employer	Suspension or revocation of employee's license; none against marine employer
Testing responsibility and timeliness	Marine employer—as soon as practical	Marine employer—as soon as practical
Postaccident drinking	No prohibition	No prohibition
Testing equipment required	Not specified	▪ Breath testing devices (oceangoing vessels) ▪ Urine specimen collection and shipping kits (only required on board if not obtainable in 24 hours)

*The Coast Guard received authority in late 1996, after the *Julie N* accident, to impose civil penalties on marine employers or anyone else failing to comply with the regulations for postaccident testing.

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: May 19, 1998

In reply refer to: M-98-82

Mr. John G. Melrose
Commissioner
Maine Department of Transportation
16 State House Station
Augusta, Maine 04333-0016

The 560-foot-long Liberian tankship *Julie N,* carrying a cargo of heating oil, collided with the south bascule pier of the Portland-South Portland (Million Dollar) Bridge in Portland, Maine, about 1105 on September 27, 1996. The vessel had passed between the piers of the new Portland-South Portland bridge (Casco Bay Bridge) and was en route to the Rolling Mills terminal about 1.2 miles beyond the Million Dollar Bridge. The vessel was under the direction of a State-licensed docking master (pilot). After the collision, the pilot stated that as the vessel approached the bridge, he had issued three orders for port rudder to swing the bow to the left and then intended to order the rudder to hard starboard and to increase the engine speed from slow to half ahead to stop the swing and align the vessel for passage through the drawspan. However, the pilot inadvertently ordered the rudder to hard port instead of hard starboard. He recognized his error within seconds and ordered the rudder to hard starboard; given the narrowness of the bridge span, however, the shifting of the rudder occurred too late to avoid the collision.[1]

There were no injuries, but the collision resulted in a 30-foot-long hole in the vessel's hull beneath the waterline. About 4,000 barrels of oil spilled into the harbor. The vessel sustained about $660,000 in damage, and the cost for cleanup of the oil was approximately $43 million. Repairs to the Million Dollar Bridge were about $232,000.

The National Transportation Safety Board determines that the probable cause of the collision with the Portland-South Portland (Million Dollar) Bridge was the pilot's inadvertent order to port (left) rudder instead of starboard (right) rudder. Contributing to the accident was the narrow horizontal clearance of the bridge drawspan, which afforded little leeway for human error. Contributing to the severity of the damage to the vessel and to the amount of oil spilled was a corner of the bridge pier that was not adequately shielded by the timber fender system.

[1]For additional information, refer to Marine Special Investigation Report—*Postaccident Testing for Alcohol and Drugs in the Marine Industry and the Ramming of the Portland-South Portland (Million Dollar Bridge) at Portland, Maine, by the Liberian Tankship* Julie N *on September 27, 1996* (NTSB/SIR-98/02).

Improving the chances of successfully navigating the bridge would require altering the procedures, vessels, or environment so that the job is made easier. The Casco Bay Bridge, completed in 1997, accomplished this by doubling the width of the opening for vessel traffic from 98 to 196 feet, which should reduce the number of bridge contacts by relaxing tolerances for passage and allowing pilots to recover from minor errors during lineup. This added space will give pilots a considerably larger margin for correcting an improper lineup.

Also, it is possible to design systems that are more error-tolerant. For example, fender systems can be designed to offer protection to the vessel as well as the bridge in case of an error in lineup or in conning the vessel. The much improved fender system at the new bridge is far more capable of buffering contact than the former timber fender system. The Safety Board concludes that the increased horizontal clearance and the improved fender system at the new bridge have greatly improved safety for the class of vessels that normally would have transited the old bridge and should reduce the likelihood of the bridge being struck by similar class vessels.

Since any navigational improvement, such as a wider bridge opening, can result in increased vessel traffic, often by larger and different types of vessels, new safety problems are likely to be encountered in the accident area. As the character of marine traffic changes over time, the margin of safety initially attributable to the greater clearance of the new bridge may decrease as increasingly larger vessels transit the bridge. Larger tankships are already operating and could start to call in Portland. Also, land area is available upstream of the bridge; therefore, port development (such as container ship operations) above the bridge is possible. Container ships with extensive sail areas may introduce problems in piloting and ship control that differ significantly from any associated with piloting tankships of the size that have historically called at Portland. Thus, the introduction of the different classes of vessels that can now transit the new bridge may require changes in the piloting methods used to conn some vessels through the bridge. Also, new operational guidelines may be needed to meet changes in the character of navigation.

The Port Safety Forum, by bringing together those having various interests in the port, appears to offer an appropriate means of assessing the needs of navigation safety on a continuing basis and to aid in developing operational guidance for vessels. In Portland, any future operational guidance for vessels would likely involve guidance on how and when to transit the new bridge. To ensure that the Port Safety Forum is regularly apprised of any problems associated with navigation through the bridge or with the bridge itself, including observations by the bridge tenders, the Safety Board concludes that participation in the Port Safety Forum by a representative of the MDOT who is familiar with bridge design or bridge maintenance would apprise the Port Safety Forum of problems involving the Casco Bay Bridge. Therefore, the National Transportation Safety Board recommends that the Maine Department of Transportation:

> Nominate a representative familiar with bridge design or bridge maintenance to participate on the Portland Port Safety Forum. (M-98-82)

Also, the Safety Board issued Safety Recommendations M-98-69 through -81 to the U.S. Coast Guard, M-98-83 to the Federal Highway Administration, and M-98-84 to the American Association of State Highway and Transportation Officials.

The National Transportation Safety Board is an independent Federal agency with the statutory responsibility "to promote transportation safety by conducting independent accident investigations and by formulating safety improvement recommendations" (Public Law 93-633). The Safety Board is vitally interested in any action taken as a result of its safety recommendations. Therefore, it would appreciate a response from you regarding action taken or contemplated with respect to the recommendation in this letter. Please refer to Safety Recommendation M-98-82 in your reply. If you need additional information, you may call (202) 314-6457.

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in this recommendation.

By: Jim Hall
Chairman

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: May 19, 1998

In reply refer to: M-98-83

Honorable Kenneth R. Wykle
Administrator
Federal Highway Administration
Washington, D.C. 20590

The 560-foot-long Liberian tankship *Julie N,* carrying a cargo of heating oil, collided with the south bascule pier of the Portland-South Portland (Million Dollar) Bridge in Portland, Maine, about 1105 on September 27, 1996. The vessel had passed between the piers of the new Portland-South Portland bridge (Casco Bay Bridge) and was en route to the Rolling Mills terminal about 1.2 miles beyond the Million Dollar Bridge. The vessel was under the direction of a State-licensed docking master (pilot). After the collision, the pilot stated that as the vessel approached the bridge, he had issued three orders for port rudder to swing the bow to the left and then intended to order the rudder to hard starboard and to increase the engine speed from slow to half ahead to stop the swing and align the vessel for passage through the drawspan. However, the pilot inadvertently ordered the rudder to hard port instead of hard starboard. He recognized his error within seconds and ordered the rudder to hard starboard; given the narrowness of the bridge span, however, the shifting of the rudder occurred too late to avoid the collision.[1]

There were no injuries, but the collision resulted in a 30-foot-long hole in the vessel's hull beneath the waterline. About 4,000 barrels of oil spilled into the harbor. The vessel sustained about $660,000 in damage, and the cost for cleanup of the oil was approximately $43 million. Repairs to the Million Dollar Bridge were about $232,000.

The National Transportation Safety Board determines that the probable cause of the collision with the Portland-South Portland (Million Dollar) Bridge was the pilot's inadvertent order to port (left) rudder instead of starboard (right) rudder. Contributing to the accident was the narrow horizontal clearance of the bridge drawspan, which afforded little leeway for human error. Contributing to the severity of the damage to the vessel and to the amount of oil spilled was a corner of the bridge pier that was not adequately shielded by the timber fender system.

[1]For additional information, refer to Marine Special Investigation Report—*Postaccident Testing for Alcohol and Drugs in the Marine Industry and the Ramming of the Portland-South Portland (Million Dollar Bridge) at Portland, Maine, by the Liberian Tankship* Julie N *on September 27, 1996* (NTSB/SIR-98/02).

Evidence that navigating through the Million Dollar Bridge was a demanding task is apparent upon examination of the 20-year history of bridge contacts made by various ships and barges under the control of various ships' captains and pilots. According to the October 1986 Maine Department of Transportation *Portland Bridge Fender Damage Summary of Bridge Operator Reports* to the Coast Guard Marine Safety Office in Portland, Maine, 46 cases of bridge damage caused by vessels occurred between January 1976 and May 1986. Two more cases were recorded in 1987 and one in 1988. From 1989 through 1996, 22 collisions with the bridge or fender system were recorded. The bridge tenders logged only those contacts in which damage to the fender system occurred. Frequent contact was a strong indication that the passage through the bridge was too narrow for modern shipping traffic.

The east corner of the south bridge pier, which the vessel struck to produce the 30-foot-long tear in the underwater hull, could have been better shielded by fendering, as it was following the accident. However, the corner had never been a problem before because large inbound and outbound vessels normally maneuver so as to pass very close to the north fender system, a procedure that kept large vessels away from the south pier. Hence, the potential risk to tank vessels posed by the corner was not recognized. However, large vessels proceeding outbound have occasionally made contact with the fender system around the west corner of the north bascule pier. Although occasional damage has occurred to the fender system, there is no record of any vessel being holed.

The bridge's fender system was not designed to protect the bridge from the types of vessels, which have steadily increased in size, that routinely navigate its draw. In addition, the fender system was insufficient to prevent damage to bridge elements from severe impacts. The Safety Board concludes that the bridge's fender system did not provide adequate protection for the bridge or for vessels navigating through its draw.

Improving the chances of successfully navigating the bridge would require altering the procedures, vessels, or environment so that the job is made easier. The Casco Bay Bridge, completed in 1997, accomplished this by doubling the width of the opening for vessel traffic from 98 to 196 feet, which should reduce the number of bridge contacts by relaxing tolerances for passage and allowing pilots to recover from minor errors during lineup. This added space will give pilots a considerably larger margin for correcting an improper lineup.

Also, it is possible to design systems that are more error-tolerant. For example, fender systems can be designed to offer protection to the vessel as well as the bridge in case of an error in lineup or in conning the vessel. The much improved fender system at the new bridge is far more capable of buffering contact than the former timber fender system. Consequently, the Safety Board concludes that the increased horizontal clearance and the improved fender system at the new bridge have greatly improved safety for the class of vessels that normally would have transited the old bridge and should reduce the likelihood of the bridge being struck by similar class vessels. Therefore, the National Transportation Safety Board recommends that the Federal Highway Administration:

> Inform, in cooperation with the American Association of State Highway and Transportation Officials, State highway departments of the circumstances of this

accident and recommend that the States evaluate the adequacy of fendering systems at bridge piers where the systems were not designed for the type and size of vessel currently using the waterway and may not be adequate to protect the bridge and take corrective action as necessary. (M-98-83)

Also, the Safety Board issued Safety Recommendations M-98-69 through -81 to the U.S. Coast Guard, M-98-82 to the Maine Department of Transportation, and M-98-84 to the American Association of State Highway and Transportation Officials.

Please refer to Safety Recommendation M-98-83 in your reply. If you need additional information, you may call (202) 314-6457.

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in this recommendation.

By: Jim Hall
Chairman

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: May 19, 1998

In reply refer to: M-98-84

Mr. Francis B. Francois
Executive Director
American Association of State Highway and
Transportation Officials
444 North Capitol Street, NW
Suite 249
Washington, D.C. 20001

The 560-foot-long Liberian tankship *Julie N,* carrying a cargo of heating oil, collided with the south bascule pier of the Portland-South Portland (Million Dollar) Bridge in Portland, Maine, about 1105 on September 27, 1996. The vessel had passed between the piers of the new Portland-South Portland bridge (Casco Bay Bridge) and was en route to the Rolling Mills terminal about 1.2 miles beyond the Million Dollar Bridge. The vessel was under the direction of a State-licensed docking master (pilot). After the collision, the pilot stated that as the vessel approached the bridge, he had issued three orders for port rudder to swing the bow to the left and then intended to order the rudder to hard starboard and to increase the engine speed from slow to half ahead to stop the swing and align the vessel for passage through the drawspan. However, the pilot inadvertently ordered the rudder to hard port instead of hard starboard. He recognized his error within seconds and ordered the rudder to hard starboard; given the narrowness of the bridge span, however, the shifting of the rudder occurred too late to avoid the collision.[1]

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The National Transportation Safety Board determines that the probable cause of the collision with the Portland-South Portland (Million Dollar) Bridge was the pilot's inadvertent order to port (left) rudder instead of starboard (right) rudder. Contributing to the accident was the narrow horizontal clearance of the bridge drawspan, which afforded little leeway for human error.

[1]For additional information, refer to Marine Special Investigation Report—*Postaccident Testing for Alcohol and Drugs in the Marine Industry and the Ramming of the Portland-South Portland (Million Dollar Bridge) at Portland, Maine, by the Liberian Tankship* Julie N *on September 27, 1996* (NTSB/SIR-98/02).

Contributing to the severity of the damage to the vessel and to the amount of oil spilled was a corner of the bridge pier that was not adequately shielded by the timber fender system.

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The east corner of the south bridge pier, which the vessel struck to produce the 30-foot-long tear in the underwater hull, could have been better shielded by fendering, as it was following the accident. However, the corner had never been a problem before because large inbound and outbound vessels normally maneuver so as to pass very close to the north fender system, a procedure that kept large vessels away from the south pier. Hence, the potential risk to tank vessels posed by the corner was not recognized. However, large vessels proceeding outbound have occasionally made contact with the fender system around the west corner of the north bascule pier. Although occasional damage has occurred to the fender system, there is no record of any vessel being holed.

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Improving the chances of successfully navigating the bridge would require altering the procedures, vessels, or environment so that the job is made easier. The Casco Bay Bridge, completed in 1997, accomplished this by doubling the width of the opening for vessel traffic from 98 to 196 feet, which should reduce the number of bridge contacts by relaxing tolerances for passage and allowing pilots to recover from minor errors during lineup. This added space will give pilots a considerably larger margin for correcting an improper lineup.

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class vessels. Therefore, the National Transportation Safety Board recommends that the American Association of State Highway Transportation Officials:

> Inform, in cooperation with the Federal Highway Administration, State highway departments of the circumstances of this accident and recommend that the States evaluate the adequacy of fendering systems at bridge piers where the systems were not designed for the type and size of vessel currently using the waterway and may not be adequate to protect the bridge and take corrective action as necessary. (M-98-84)

Also, the Safety Board issued Safety Recommendations M-98-69 through -81 to the U.S. Coast Guard, M-98-82 to the Maine Department of Transportation, and M-98-83 to the Federal Highway Administration.

The National Transportation Safety Board is an independent Federal agency with the statutory responsibility "to promote transportation safety by conducting independent accident investigations and by formulating safety improvement recommendations" (Public Law 93-633). The Safety Board is vitally interested in any action taken as a result of its safety recommendations. Therefore, it would appreciate a response from you regarding action taken or contemplated with respect to the recommendation in this letter. Please refer to Safety Recommendation M-98-84 in your reply. If you need additional information, you may call (202) 314-6457.

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in this recommendation.

By: Jim Hall
Chairman